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Producer Gas Plant Design

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(*Written for* THE GLASS INDUSTRY)

The process of combining raw materials by melting or fusing to form a single compound from which the finished article is manufactured, requires the application of heat. The fuel required to produce this heat may be fired directly or indirectly in solid, liquid or gaseous form. In large scale melting operations the fuel is generally applied, for combustion, in either liquid or gaseous form directly to the material to be melted, as in a furnace with an open hearth such as a glass tank or open hearth steel furnace or indirectly as when applied to pots or crucibles which are set into the combustion chamber of a furnace. In some cases the fuel is introduced in finely divided solid form. This practice for melting operations is, however, rare as compared with the other two methods of fuel application.

The method of application which is perhaps most generally used in the glass, steel, and chemical industries is that in which the fuel is in a gaseous state.

The ideal gaseous fuel as applied to the glass furnace or for that matter, any melting or heat treating furnace, from the standpoint of ease of application and manipulation, is of course natural gas. This fuel is, however, as we all realize with regret, rapidly becoming too expensive or difficult to procure in sufficient quantities for continuous large scale melting and as a substitute for this natural fuel hot raw producer gas is now generally used by a very large number of industries in which melting or heat treating constitutes a major operation in manufacture.

The fuel problem in the metallurgical and chemical industry is a very important one and involves such large sums of money that it becomes a necessity to practice the utmost economy in the production, transmission and application of the fuel used in the processes of manufacture.

In no other branch of energy transformation in the industrial plant is there more apt to be trouble and annoyance caused by some oversight or lack of forethought in design or choice of equipment than in the producer gas plant.

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In designing the gas plant much thought should be given to the question of insuring the production of gas free from distracting incidental operations caused by the necessity of keeping some weak point working properly, and great care should be taken to secure continuity of operation. This will result in increased efficiency of melting operations and greater satisfaction to all. The outstanding reason why in the past a great many producer installations have been considered as plant nuisances is that there has been too great a tendency to relegate them to second place when installing furnace equipment without giving much thought as to whether they were adequate for and adapted to the work they were supposed to do.

It is the purpose of the following article to discuss briefly some of the most fundamental factors to be considered in the design of a producer gas plant.

It may be well to specifically state here that the term producer gas as here used refers to what is termed "raw" or hot producer gas. The gas in this case is transmitted directly to the furnace for combustion just as it is evolved in the producer, carrying with it tar vapor and large quantities of coke dust and broken down hydrocarbons in the form of soot, and is not treated to any intensive cleaning process for the removal of these by-products.

In the process of designing the plant and in the selection of individual equipment there are a few things to be kept in mind which will aid in the final success of the installation.

Below are listed six factors which enter into the design of every producer gas installation. They are general in character and when applied to this subject may be used as a basis upon which a design may be built.

(1) Plant location.
(2) Plant capacity.
(3) Selection of equipment.
(4) Provision for future extension.
(5) Arrangement and accessibility of equipment for ease of operation and maintenance.
(6) The gas distributing system.

In addition to these six factors there are two other fundamental principles which are of great importance in producer gas plant design. These are *simplicity* and *ruggedness.* It is possible and permissible in many departments of the factory —in the power plant or in the manufacturing department— to use successfully many ingenious and perhaps complicated mechanical appliances which are fine examples of engineering skill and which with a normal amount of attention may be made to perform their functions satisfactorily and continuously. It is, however, the safest proposition to keep inventive genius out of the gas plant unless it is tempered with some years of *practical* experience in operating producers and handling producer gas. This experience will produce a very conservative frame of mind in the inventor for he will have long since come to the realization that many good and well-meaning devices when subjected to intense heat and mixed with tar and soot produce very disheartening results. In short, true mechanical and structural simplicity has been proven many times to be the safe and satisfactory rule to follow in producer gas construction.

Ruggedness of construction is of course an essential in any mechanical or structural design and therefore is evidently a very necessary consideration in the class of work under discussion.

PLANT LOCATION

In every well designed industrial plant of the present day we find the process of manufacture taking place in straight lines; that is, the raw materials are received and started in at one end and progress steadily in straight lines until the finished product emerges at the other end. No back tracking of any material in any process of manufacture is the ideal arrangement in industrial engineering.

Fig. 1 illustrates a typical factory layout embodying this idea of straight line progression in manufacture.

There are of course possible many modifications of this arrangement, and where it is possible to design the factory without undue restrictions as to ground space the question of location of the gas plant is a simple one. It is, however, not such a simple matter to re-arrange an existing factory layout to conform to this convenient and desirable arrangement if during its development no particular consideration has been given to the matter of the arrangement of buildings.

It is not infrequently the case that in the development, let us say, of a glass factory one or more producers of the hand poked type have been set down adjacent to one furnace or a group of furnaces and later on it is desired to centralize the producer gas equipment and take advantage of the economy resulting from the labor saving mechanical type of producer.

Or it may be that the factory is located where natural gas has been available in unlimited quantities and its development progressed far with this convenient fuel at hand. It is then often the case that a time comes when either the cost of natural gas reaches a figure where it becomes a marked economy to install producers or the supply becomes uncertain and inadequate, necessitating the substitution of producer gas as a more dependable fuel. Under these circumstances when considering a satisfactory location for the gas plant it is a serious handicap to find that buildings have been set up without apparently much thought regarding an ultimate layout.

In the selection of a site for gas producers in the glass plant it is of considerable importance to give consideration to the keeping of dust and soot, which to a greater or less degree is an ever present by-product of producer gas, out of the factory proper. This dust and soot produces more trouble and annoyance in the manufacture of glass than is the case in any other line of manufacture where producer gas is extensively used as fuel, and therefore more attention should be given to its control. The simplest means of combating this trouble is to locate the gas plant at some distance from the factory, but much better than this, the design should

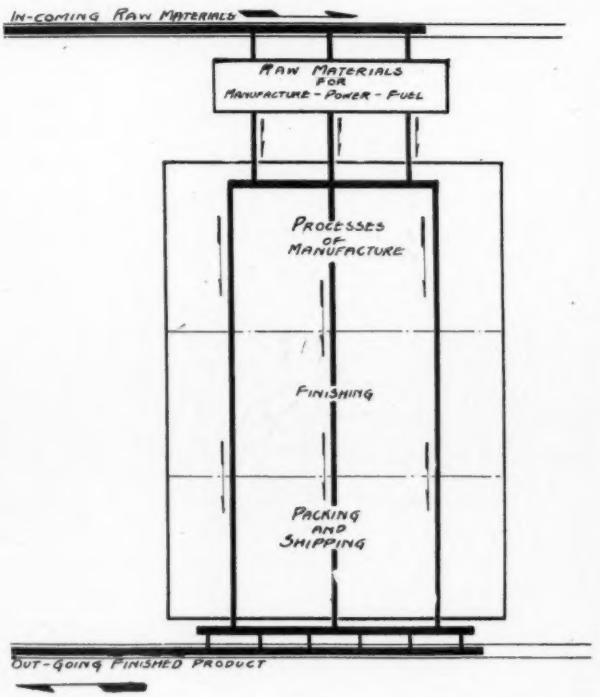

FIG 1. TYPICAL FACTORY LAYOUT DESIGNED FOR "STRAIGHT LINE" HANDLING OF MATERIALS.

be worked out so that the minimum of dust is allowed to escape and blow about. All hopper gates and openings for dumping dust from the system should be protected from the wind and preferably provided with a spray of water for the purpose of dampening down the dust as it is discharged.

A producer gas plant to operate with the greatest degree of success, whether it is to be a central plant designed to supply a number of existing furnace installations or is a part of a newly designed plant where there is greater latitude allowable in the selection of the location, should be located so that the system for distributing the gas to all furnaces will be the shortest possible consistent with the layout. Under no conditions, however, is it advisable to scatter single producers around the plant in relatively inaccessible locations, without thought as to how the arrangement will work out when expansion of the plant takes place, just for the purpose of getting the producer adjacent to the furnace.

In deciding upon the matter of location such questions as

coal storage, coal handling, ash handling and gas distribution are perhaps the most important considerations to be settled. The location should be such that a reasonably large coal storage is available, especially if the geographical location makes it advisable to keep a coal supply of from three to six weeks ahead. On the other hand where coal fields are adjacent it may not be of such importance to utilize so large an area for coal storage. Coal handling in a large plant of say seventy-five tons and over is of considerable importance and is closely related to the gas distributing system. It is of greater importance to keep down the length of gas mains to a number of furnaces at the expense of a more elaborate coal handling system than vice versa, for the reason that short gas mains greatly aid in keeping down the first cost of the installations, make operation simpler and within certain limits give better results. Consider a case where it is desirable to locate the gas plant as shown in Fig. 1, but in order to keep the producers in one building a distributing system of gas mains ranging from 250 to 400 feet or more in length would be required, while by dividing the plant into two or more separate units connected by a single coal handling arrangement it would be possible to reduce the run of mains to lengths ranging from 50 to 100 feet. Under these conditions the latter arrangement would unquestionably be the better and more satisfactory of the two.

Fig. 2 shows a modern producer gas installation serving a battery of open hearth furnaces at a large steel plant in which this idea is well carried out. The producer plant located as shown, directly back of the furnace building, is divided into three separate installations, each installation consisting of three mechanical producers supplying gas to two furnaces and each having an independent system of gas mains. The only connection between the three buildings being the coal distributing system, which consists of an electric driven coal larry. This arrangement reduces greatly the amount of gas main required, reduces the labor of cleaning the same and results in a much less unwieldy installation than if all the producers were connected by a common header, and at the same time operation and supervision is practically the same as if the installation were a single unit.

Preferably, in selecting a location for the gas house, one should be chosen where the removal of ashes may be easily effected by very simple means.

In short, careful thought should be given to the selection of a suitable location for the producer gas plant and in doing so the four factors mentioned, together with any others arising from special conditions should be carefully considered and proper importance attached to each, being careful not to allow some minor plan or hazy possibility to outweigh the more important factors in arriving at a satisfactory decision.

PLANT CAPACITY

The capacity of a producer gas plant is usually expressed in tons of coal gasified per day (24 hours), while the capacity of the individual producer may be expressed in tons of coal gasified per day (24 hours), pounds of coal gasified per hour, or in general terms, pounds of coal gasified per square foot of fuel bed area per hour. The latter unit of capacity expresses the rate of gasification irrespective of size or design while the other two units are perhaps the most generally used when considering a definite size and type of producer.

Producers may be divided into two general types, viz., hand-poked and mechanical. The distinguishing difference between these two types is that in the former the fuel bed lies practically undisturbed except for a small amount of irregular and intermittent hand-poking by the fireman, this being occasioned principally by the necessity of closing blow holes or chimneys which frequently work their way up to the surface of the fire and is not actually intended for the purpose of agitating the fuel bed, while in the latter the fuel bed is mechanically and continuously agitated or sliced and in some cases the surface of the fire kept leveled off. This mechanical manipulation of the fuel bed produces two beneficial results, viz: (1) The fuel is kept in constant motion, the individual lumps of coal are turned over and over exposing all sides to the greatest effect of the blast which is, of course, on the sides and bottom of the lump as the blast and gases pass upwards; and (2) the continuous mechanical

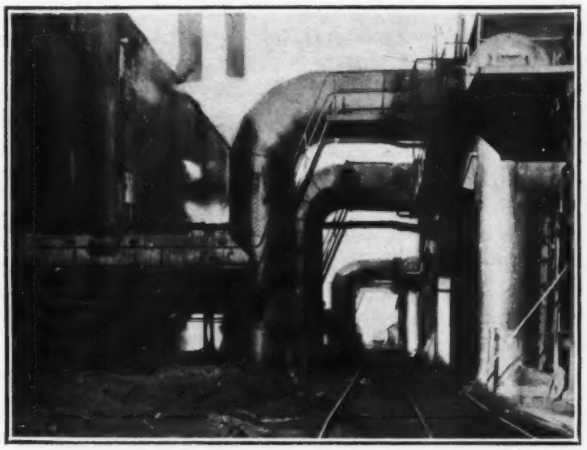

FIG. 2. A MODERN PRODUCER GAS PLANT.

agitation, in the nature of stirring and slicing, maintains the fuel bed in a homogeneous, mellow mass and at the same time prevents caking of the fuel, and also prevents chimneys or blow holes from forming. Due chiefly to the differences just described together with such features as fuel bed thickness and blast conditions, which will be taken up more fully in a later discussion, the gasification rate of the mechanical producer is very much higher than that of the hand-poked type.

Under ordinary operating conditions with an average grade of gas coal the average rate of gasification of the types of hand-poked producers in general use is approximately twelve (12) pounds of coal per square foot of fuel bed area per hour. With the gasification rate known it is a simple matter if the total tonnage of coal to be gasified is known to settle upon the number of producers required of whatever kind or type may be chosen.

As an example let us say that it will require the gasification of 25 tons of coal per day (24 hours) to operate a given glass furnace of the continuous tank type. This is

equivalent to 2,083 pounds of coal gasified per hour for the plant and at the rate for hand-poked producers of 12 pounds coal per square foot per hour, the fuel bed area required will be $\frac{2,083}{12} = 173.6$, say 174 square feet. This area could be obtained in three hand-poked producers having an internal diameter of 8 feet 6 inches, or with two of 10 feet 6 inches internal diameter.

It is possible to secure shells for hand-poked producers in almost any diameter while the five or six well known mechanical producers are built with shells which provide a fuel bed diameter of 10 feet or 10 feet 6 inches, so that with the fuel bed area fixed it is customary to speak of the capacity of these producers in terms of pounds of coal gasified per hour or per day (24 hours). The manufacturer's rating, however, for these producers is approximately 38 pounds of coal gasified per square foot of fuel bed area per hour. It will be seen then that at a 38 pound per square foot per hour rate, one mechanical producer will gasify from 36 to 40 tons of coal per day (24 hours). It is evident therefore that for a small installation of under 50 tons of coal per day (24 hours), it would be best not to consider the high capacity producer unless the installation of a single mechanical unit is to be the first of a number which will eventually be installed.

Midway between the hand-poked and mechanical type of producer, in the matter of rating, comes the semi-mechanical producer, which is the stationary shell of the hand-poked producer upon which is mounted a top of special design upon which is carried one or more members used to keep the fuel bed broken up, the surface uniform and level and for imparting a rolling and tumbling action to the top layer of fuel. This intermediate type of producer has a gasification rate of about 20 pounds of coal per square foot of fuel bed area per hour. In the example just cited two 8 foot 6 inch internal diameter producers with mechanical tops would be required for the gasification of 25 tons of coal per day (24 hours).

When deciding upon the producer capacity necessary to furnish sufficient gas for a given furnace installation it is necessary of course to know first what will be the fuel requirements of all the furnaces to be supplied. In order to determine within practical limits the consumption of producer gas for any given furnace installation, one of the three following methods may be used. The results obtained will be only approximations but if used as such, with a conservative allowance for reserve capacity, they will suffice for all practical purposes.

(1) If the new furnace is to be similar to others already operating with producer gas as fuel, then a careful estimate of the number of tons of coal to be gasified, based on information regarding fuel consumption of the furnaces in operation, will be sufficiently accurate to indicate the necessary requirements.

(2) When gas producers are to be installed and producer gas used to replace natural gas or oil as furnace fuel it is customary to equate the fuel value of the natural gas or oil to that of coal, allowing an average efficiency of the entire producer gas system of say 75%. As an example, let us assume that 1,000,000 cubic feet of natural gas per day (24 hours) has been required for a certain number of glass furnaces, lehrs, etc., and it is desired to replace this with producer gas. By equating fuel values we have:

Average heat value per cu. ft. natural gas.....1,100 B.t.u.
Average heat value bituminous coal per lb.....13.500 B.t.u.
Average efficiency of producer gas system..... 75%
T = Equivalent tons of coal to be gasified per day (24 hours)

$$1,000,000 \times 1,100 = 13,500 \times .75 \times 2,000 \times T$$

$$T = \frac{1,000,000 \times 1,100}{2,000 \times 13,500 \times .75} = 54.3 \text{ tons of coal per day (24 hrs.)}$$

$$= 4,525 \text{ lbs. per hour.}$$

(3) In case no previous information is available regarding fuel consumption of a given type of furnace it is possible to calculate with a reasonable degree of accuracy the number of tons of coal required to melt a known quantity of glass providing the design of the furnace has been predetermined. This method is, however, more difficult than the other two just mentioned and requires the use of coefficients of heat transmission of various refractory materials used in the construction of the furnace together with data regarding the heat required for melting the glass batch. Briefly, the method followed in making this determination is to compute the total area of exposed surface of the furnace and by the use of proper coefficients of heat transmission for the various refractory materials composing the furnace structure, the total radiation loss may be calculated. The heat required to replace this loss plus the heat required to melt the glass batch constitutes the total heat to be supplied to the furnace. With this known heat quantity it is possible to determine the weight of coal to be gasified.

Method number two, while quite generally used by some for comparing natural gas, oil, producer gas and other fuels, as regards combustion, is fundamentally incorrect when used to compare, for high temperature work, their relative merits as furnace fuels, on account of the fact that the combustion characteristics and flame temperatures of these fuels are quite different so that although two quantities of different fuels may have the same total heat value in B.t.u. they will produce entirely different results when burned in a high temperature furnace under the same conditions. It will be attempted later, under the head of "Producer Gas Combustion," to bring out more clearly this difference in fuels as used in the glass melting furnace.

A word may be said before leaving the subject of "Capacity," regarding the important matter of allowing sufficient spare capacity as insurance against unforeseen accidents. It is of course a good plan to provide auxiliary fuel on a furnace in case the main fuel supply should fail but this is no reason for not allowing sufficient reserve capacity in the producer plant so that in case one unit is temporarily out of commission the remaining units will satisfactorily carry the load. The change from one fuel to another on the furnace is a troublesome and costly operation. Proper adjustments have been made for one fuel and a change of fuel necessitates an upset and readjustment which may disturb conditions in the furnace sufficiently to stop or retard production for a time.

In discussing above the pounds per square foot per hour rating for different producers the rate for the ordinary hand-poked producer was given as 12 and for semi-mechanical 20, and full mechanical as 38. This rate for hand-poked producers is conservative as it is possible by forcing the producer to increase this to 16 at the expense of grate efficiency (high percent of carbon in ash) and also gas quality, but nevertheless if necessary this rate can be maintained. The same cannot be said of the semi- and full mechanical producers. Here the 20 and 38 pound per square foot per hour are the actual capacities of the producers and if not the maximum, so closely approach it as to make them unsafe to use unless with a good margin of reserve capacity. These producers will, however, come up to this capacity for a short time, as for instance during a test or under conditions similar to open hearth steel furnace practice where they are operating for six or eight hours and down for one hour or more, during which time the fires can be gotten into good condition for the next run; but for service of 24 hours per day, seven days a week, it is far safer and better to use these ratings with a factor of .75 or .80 and be sure of preventing trouble at the start. In short, sufficient producer capacity should be provided so that the equipment will not be taxed to the limit, for a plant operating under these conditions, where no reserve is available, will always be at a disadvantage for the slightest upset in any part of the system will cause more or less serious trouble and delay at the furnace.

[This article will be continued in the January number. The author takes up in turn the Selection of Equipment, Provision for Future Extensions, Arrangement and Accessibility of Equipment for Operation and Maintenance, The Gas Distributing System and other phases of the subject.—Ed.]

Fuel Saving in Modern Gas Producers*

By W. B. CHAPMAN†

There are about 10,000 gas producers in the United States. With the exception of the modern mechanical producer, most of these are "sick" and badly in need of a "gas doctor," and the furnaces they supply are in an equally bad way.

The producers in use are divided approximately as follows: 6,500 in the steel industries; 1,500 in the glass industries; 500 in the chemical industries, and 1,500 in miscellaneous industries. Under "miscellaneous" are included the ceramic industries, lime burning and about 200 gas producers used for power.

Engineers have given much attention to the engine room, some to the boiler room, a little to industrial furnaces, and least of all to the making of raw producer gas. Hence the backward condition of the gas house.

No definite data have been compiled by the Government on the amount of coal used in gas producers, but with the assistance of such figures as are available it is estimated roughly that in the steel industries about 15,000,000 tons of bituminous coal are transformed annually into raw producer gas for use, and in the glass industries about 2,000,000 tons.

In the steel industries about the same amount of coal is used for making gas to heat furnaces as for making steam. In glass making three-fourths of all the fuel is used in gas producers. But wherever producer gas is used it is apt to be the most backward part of the business. A given amount of time and money, if spent on improving conditions in the gas house, will usually bring larger returns than in any other department. In most industries requiring large heating operations more trouble arises in that department than in any other part of the business.

Much progress has been made in the past 25 years in gas-producer construction. It started with the excellent work of W. B. Hughes. Progress in furnace construction, however, has lagged. The chief incentive to improvement of both producer and furnace has been high-priced labor, and the few advances made in furnace construction have been confined mostly to certain labor-saving features. Now the situation has changed; fuel saving has been put on a par with labor saving, and interest is being noted all along the line.

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THE PRODUCER-GAS PROCESS

In making producer gas there are three steps or operations: (1) Feeding the fuel; (2) agitating the fire; and (3) removing the ashes. Progress in producer construction has centered on various ways of performing these three operations automatically.

Automatic Coal Feeding, if continuous and uniform, will increase the B.t.u. in the gas about 10 per cent and will improve its uniformity to such an extent that it can be burned in the furnace with a 10 per cent improvement in economy. However, the labor saving due to automatic feeding is slight, and should not be confused with the labor saved by the use of coal-handling equipment and overhead bins, always a good investment for installations of more than one producer.

Automatic Agitation, if suited to the kind of coal used, will increase the B.t.u. from 10 to 20 per cent (depending largely upon the zeal and skill with which it was formerly hand-poked) and the uniformity thus obtained will cause a corresponding saving in utilizing the gas in the furnace. The combined effect of automatic feeding and automatic agitation usually makes possible a saving of 25 per cent of the fuel required for a given operation.

Automatic Ash Removal is of two kinds—intermittent and continuous discharge. The intermittent type removes the ashes once or twice in 24 hours. It is open to the objection that during the ash-removal period the fire is badly disorganized and a poor quality of gas is made for possibly half an hour. The continuous type of ash removal is entirely free from this objection. In Europe the continuous type is much

in favor, although but few have been installed in this country.

The saving caused by mechanical ash removal depends largely upon the kind of device used. If the ashes are removed intermittently, and if no effective agitation accompanies the ash removal, the saving will be limited to the two or three hours' time required daily for the ash men to shovel the ashes out by hand. If, on the other hand, the ash removal is continuous and is accompanied by suitable agitation of the entire ash bed and lower portion of the fire bed, there will be a considerable saving in the labor required both

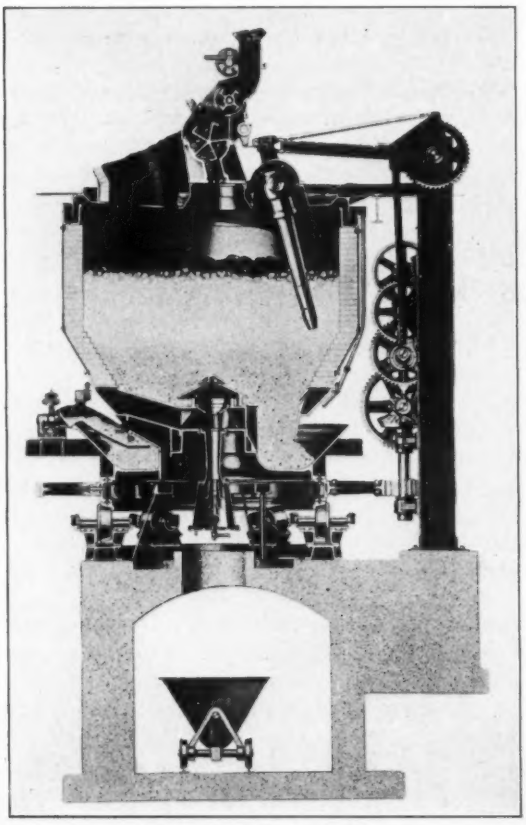

FIG. 1. HUGHES PRODUCER.

for manipulating the fire and for cleaning clinkers off the walls. Moreover, the continuous type of ash removal, accompanied by ash agitation, will increase the capacity of the producer about 50 per cent and will save some fuel on account of the improvement in the quality and uniformity of the gas. Unfortunately the continuous type of ash remover, combining with effective agitation, is little known in this country, although it is the common type in use throughout Europe.

TYPES OF PRODUCERS

Bearing in mind the foregoing three steps in making producer gas, let us now consider the types of producers in most common use in America, the Hughes, the R. D. Wood[1], the Morgan and the Chapman. Each is an excellent machine.

To Mr. Hughes, then chief engineer of the Pencoyd Iron Works, is accorded the credit for having installed at that plant in 1897 the first successful mechanical producer in America. This machine is still in operation. As will be seen from Fig. 1, the chief feature consists in a vertical water-cooled finger hinged to the stationary top of the producer and made to oscillate between the center and the wall while the body of the producer and its contents revolve underneath. Thus, in time, the entire contents of the producer are stirred. The speed of this producer was originally one revolution in 20 min., but every few years it has been increased until now the walls make one revolution in 8 min., with considerable increase in capacity.

Since the installation of the first Hughes producer, an automatic ash-removing device has been added. It consists in a stationary bar arranged to sweep the ashes from a revolving grate. The bar is inserted once or twice every 24 hours for a short period and then removed. No attempt is made to use the device for agitating the lower portion of the fire bed. Recently an automatic feed—in fact two automatic feeds—has been added, thus making the producer completely mechanical. The double feed gives unusually good coal distribution. This is the oldest producer on the market, and

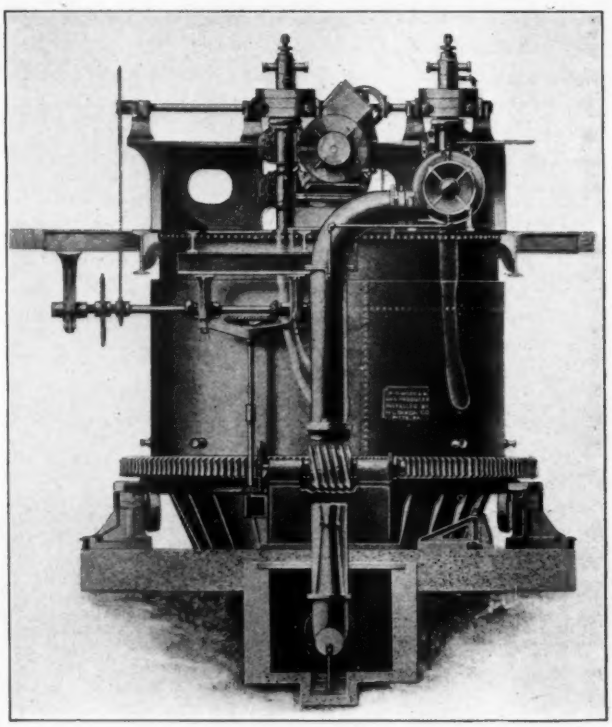

FIG. 2. R. D. WOOD PRODUCER.

there are over 800 in operation—more than any other mechanical producer.

The R. D. Wood producer, Fig. 2, is somewhat like the Hughes, in that it uses the vertical-stirring-arm principle. There are two vertical arms, one near the center and the other near the wall. These stirring arms are bent as shown in the illustration, but instead of oscillating from center to side they revolve around their vertical axes. The walls of the producer revolve and thus the fire bed is carried past the stirring device. The coal is fed from a rotating drum located eccentrically. As the revolving fire bed comes under the feeding device fresh fuel is supplied to it. The speed of the

[1]The Wood type is manufactured by two different companies.

producer is one revolution in 30 min. A steam-turbine blower is supplied in addition to the ordinary steam-jet blower. The turbine has an extra large capacity, operates quietly, and usually gives results that are more uniform than a steam-jet blower.

The ash is removed by a blade or plow attached to the lower edge of the revolving producer wall and extending down into the ash bed. The blade takes out ashes at a fixed rate, which is somewhat faster than they are made and therefore it cannot be operated quite continuously. Scoops are attached to the skirt of the revolving wall for carrying the ashes around to a suitable point for final discharge. The capacity of this producer is unusually large, owing to the facts that there are two stirring arms in place of one, and the removal of the ash is nearly continuous. Moreover, the diameter of the Wood producer is 10 ft. 6 in., instead of the usual 10 ft. This producer is particularly popular among glass manufacturers, and some remarkable records have been secured with it.

In a producer having vertical stirring fingers it is highly desirable to keep the top and bottom of the fire bed always at the same level so that the stirring fingers will always project the right distance into the fire bed for best results. If these fingers should reach too near the ashes, the air blast would break through into the recess or gap left in their wake and spoil the gas. A continuous, or at least semi-continuous ash removal would thus seem to be necessary in order to keep approximately the same amount of ashes in the fire bed all the time and approximately the same amount of fire.

The Morgan producer, Fig. 3, like the Hughes, is 10 ft. in inside diameter and has about the same capacity. Also, like the Hughes, it is very popular in the steel trade. However, it differs radically in both the method of agitation and in the ash removal. Instead of vertical arms projecting deep into the fire bed, a horizontal arm which rides on the surface is used, it being claimed that surface agitation is quite sufficient and anything more is detrimental. The writer's experience would seem to prove that surface agitation is hardly adequate when caking coals are used. Nevertheless some very excellent results have been obtained. As will be seen from the illustration, the agitator is in the form of a swinging U-tube with the ends hinged to the stationary top of the producer. The walls and the ashpan of the producer revolve and carry the fire bed around with them. The speed has recently been increased to one revolution in twelve minutes.

The ash is removed by a spiral arm lying on the bottom of the ashpan. Ordinarily the arm revolves with the pan so that no ashes are removed. From one to three times every 24 hours the outer end of the spiral arm is engaged and held fast, thus producing relative motion between the arm and the pan and causing the ashes to flow out rapidly. An ingenious device provides for the automatic release of the ash arm when the producer has made a full revolution. The ashes obtained in this way are exceptionally free from carbon. After the ashes are taken out the fire bed is "broken down" by hand poking and drops from six inches to a foot.

In all gas producers that do not provide for continuous removal of the ash there is a definite *cycle of operation*, extending from one ash-removing period to the next. This is usually a 24-hour cycle, but in some cases it is 12 or even 8 hours, and in the case of the Wood producer it is semi-continuous. At the beginning of the cycle (immediately after the ashes have been removed) the fire bed, though not changed in thickness, is located much lower down in the producer than at the end. This difference in height of the location of the fire bed in the producer from the beginning to the end of the cycle is usually about 2 ft. if the ashes are removed but once in 24 hours, but is correspondingly less when the ashes are removed more frequently. It is therefore apparent that if a producer is to be agitated uniformly it should be provided either with approximately continuous ash removal or with an agitator which automatically varies in height according to the varying height of the fire bed.

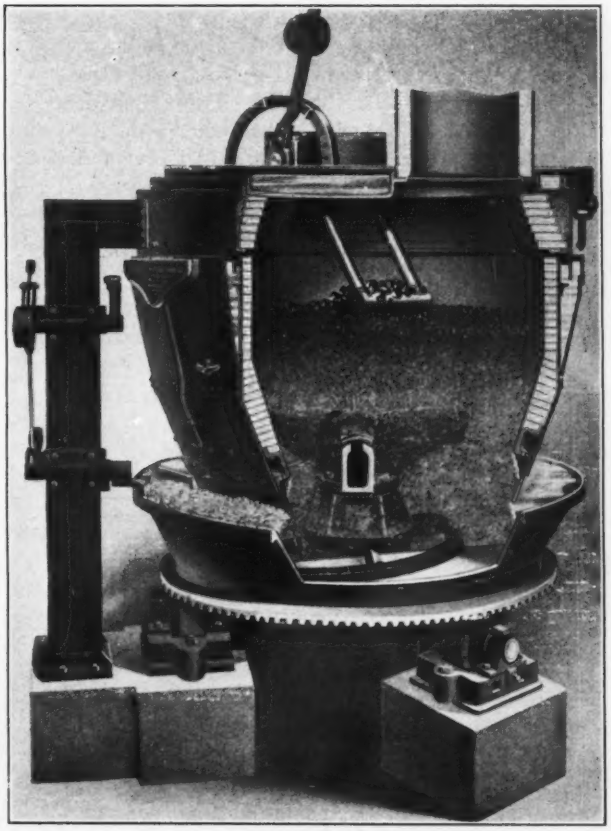

FIG. 3. MORGAN PRODUCER.

The Chapman producer, Fig. 4, is the only gas producer sold in parts. The agitator alone may be installed on any stationary producer, or the agitator in combination with the automatic feed may be installed on old or new stationary producers, or, again, a completely mechanical producer including automatic feed, agitator and ash remover may be obtained. The agitator, as will be seen from the illustrations, is in the form of a rake with water-cooled teeth. The rake revolves once in 7 min., and thus every portion of the fire is passed over every 3½ min., which is more than twice as frequent as in any other producer. In most producers agitation depends upon the speed of the walls, which are rather cumbersome to operate rapidly.

The agitator is driven by a patent driving head having two

long spiral flanges upon which the agitator automatically "screws up" as the fire bed grows higher and "unscrews" when the height of the fire bed drops. These spiral flanges are in sliding contact with two revolving lugs which project inwardly from the hub of the driving wheel. As fresh coal is put on the fire it tends to bury the agitator beneath it. This makes the agitator turn harder through the fire bed, and immediately the torque is increased the driving head screws up to where the forces are again in balance. If the agitator strikes a large clinker fast to the wall it screws up over it and drops down on the other side, thus avoiding any undue strain on the machinery. The action is a little like that of the Yankee screw driver.

The cross-arm of the agitator operates a few inches below the surface of the fire bed, and the fingers project down 8 in. farther. This makes the depth of the agitation about midway between the surface agitation of the Morgan and the deep agitation of the Hughes and Wood. As the fingers project forward the cross-arm immediately fills in the gaps in their wake. The out-stroking effect of the cross-arm tends to pack the fuel against the wall, which helps to prevent blowholes and clinkers.

The automatic feed drops the coal evenly over all parts of the fire bed simultaneously, and thus does not require a revolving fire bed. The object is to produce slightly better gas-making conditions than when the fuel is dropped only in one corner or sector of the producer at a time.

The ash-removing device operates continuously. It consists in a slowly revolving beam extending across the producer through the ashpan and driven by a gear ring which encircles the producer just above the pan, the speed being adjustable to synchronize with the rate the ashes are being made. The speed of the gear ring is adjustable from a revolution an hour to one in ten hours. After the ashes have been forced out by the beam into the outer portion of the ashpan they are picked up by scoops attached to the gear ring and carried to the point of discharge.

The Chapman producer makes use of the European idea of agitating the firebed from beneath. The ash beam is provided with fingers which project upward and impart motion both to the ashes through which they move and the fire bed resting on the ashes. This is to help in preventing blowholes and clinkers and to increase the capacity.

The size of this producer is 11 ft. inside diameter—the largest made—and the capacity is increased accordingly.

SAVINGS WITH MECHANICAL PRODUCERS

With the usual more or less unskilled and indifferent handling, any of the four American mechanical producers can make a gas averaging 150 B.t.u. (low values) instead of the customary 125 B.t.u. obtained in hand-poked producers if operated with zeal. With skilled handling the best mechanical producers will average from 160 to 175 B.t.u., provided the coal is fair and the rate of gasification does not exceed 25 or 30 lb. per sq. ft. per hour, which is about twice the capacity of hand-operated producers.

A Duff producer, operating originally at 10 tons a day and making gas having 125 B.t.u., was fitted with a Chapman agitator and automatic feed, and at 36 tons a day gave an average of 163 B.t.u. Similarly, a Von Kerpley producer, the most popular mechanical type in Europe, gasifying 20 lb. per sq. ft. per hour, making about 135-B.t.u. gas, was equipped with Chapman agitator and automatic feed and changed to 34 lb. gasified per sq. ft. per hour and 178 B.t.u. This was maintained without difficulty and without any hand poking.

The best modern producers properly operated will usually save about 25 per cent of the coal and an equal amount of labor. These savings should amount to the total cost of the installation in from one to four years.

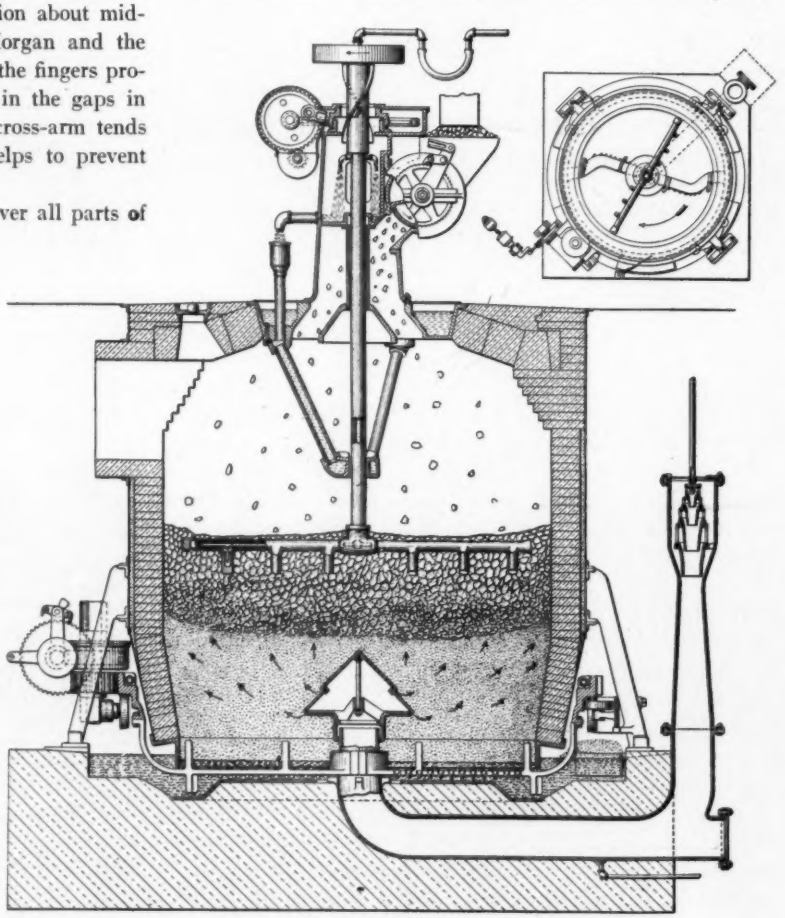

FIG. 4. CHAPMAN CONTINUOUS GAS PRODUCER.

A considerable saving of coal can be brought about by using suitable accessories in the gas house. The most important of these is a pressure regulator, which, when the pressure in the gas main falls, blows the producer harder and makes more gas, and vice versa. A temperature recorder is also of great assistance. A few additional regulating and recording devices are needed if one is to obtain the highest efficiency in daily operation.

Some Workshop Notes on Silvering

By JAMES WEIR FRENCH, D.Sc.*

[The Physical Society of London and the Optical Society[1] have published a discussion on the making of reflecting surfaces, which took place in November, 1920, at the Imperial College of Science and Technology. This publication contains a bibliography of the more important papers on the construction and nature of reflecting surfaces, and on the subject of metallic deposition on glass. Eleven articles are devoted to descriptions of various silvering processes. One of these articles is reprinted herewith. It contains only the outlines of different methods without entering into details. Since it is believed that a description of some of the more widely used processes would be interesting to our readers, the Brashear and the Rochelle salt process have been added to the original article in which these procedures receive only passing notice.—EDITOR.]

Many processes for the silvering of optical parts have been introduced from time to time, but the number in practical use is small. The best known processes are:

(1) The old Mercury Tin Amalgam process.
(2) The Formaline process.
(3) The Rochelle Salt process.
(4) The Tartaric Acid process.
(5) The Brashear process.

Numerous attempts to project under vacuum fine deposits of silver upon glass surfaces have been made, and I understand that the latest information on this subject is to be placed before the meeting. There appears to be little difficulty in producing small reflectors of 1 cm. or more in diameter. Hitherto it has been very difficult to produce large, uniformly reflecting surfaces by this method.

(1) MERCURY TIN AMALGAM PROCESS

This process, the details of which are well known, has not been used regularly in commerce for many years, and it is now rarely used by opticians, although there are still some sea-going officers who favor it from the point of view of durability. The process has been abandoned in the industry in favor of the Rochelle salt process, because of the long time —several weeks—required for the removal of the excess mercury, and principally because of the danger to health. As the final surface contains about 20 per cent of mercury, it is to be expected that the light-reflecting power is not good from the point of view of the optician.

There is a characteristic difference between the mercury tin amalgam and the precipitated silver in that the former cannot be used like the latter for surface silvering. The uniformity of the amalgam surface is dependent upon the polished surface of the glass with which it is in contact. The surface in contact with the glass appears highly reflecting, whereas the other side in contact with the air has a dull matt appearance. When, on the other hand, a thin layer of silver is deposited upon the polished surface of glass, both sides can be made highly reflecting.

(2) FORMALINE PROCESS

This process has the sole merit of being very simple and rapid, and therefore suitable for experimental work, but in the present stage of its development it is rarely used in optical manufacturing. Compared with the Brashear and Rochelle salt surfaces, the formaline surface is dark. The process has the additional disadvantage that one deposit cannot be laid upon another, and the surface cannot be electrically plated with copper.

(3) ROCHELLE SALT PROCESS[1]

This process is very generally used in commerce and by opticians. It gives a brilliant reflecting surface, which, however, is about 5 per cent or 6 per cent less brilliant than that of the Brashear process. The difference can be detected at a single reflection. It is easily detected after three or four reflections. The process has the advantage that the silver is deposited at a normal temperature, which does not require very careful regulation.

(4) THE TARTARIC ACID PROCESS

So far as brilliancy is concerned, the surfaces produced by this process are nearly comparable with those of the Rochelle salt process. From the point of view of the optician, the process has the disadvantage that the best results can be obtained only when the bath is heated to about 40° C. To subject finished optical parts to this temperature is undesirable. This objection is not applicable to such work as large flat mirrors, in which case steam-heated tables are used. A single deposit only is necessary.

(5) BRASHEAR PROCESS[2]

This process is probably the one that is most extensively used for the silvering of optical parts. It is a cold process,

*Barr & Stroud, Ltd., Glasgow.

ROCHELLE SALTS PROCESS

[1]Dissolve 5 g. of silver nitrate in 300 c.cm. of distilled water, and add dilute aqua ammonia until the precipitate formed is nearly, *but not entirely*, redissolved in the manner explained in the footnote describing the Brashear process. Filter the solution and add water to make 500 c.cm.

Dissolve one g. of silver nitrate in a small quantity of water and pour into about half a liter of boiling water; dissolve 0.83 g of Rochelle salts in a small quantity of water, and add to the boiling solution. Continue the boiling for half an hour, till the gray precipitate collects as a powder in the bottom of the flask Filter hot, and add water to make 500 c.cm.

These solutions may be kept in the dark for a month or two.

For silvering, equal volumes of the two solutions are mixed, and the glass is supported in the mixture in whatever fashion is convenient. The thickest possible deposit may require an hour's time. A second deposit may be made upon the first if necessary to secure the desired thickness. The drying and polishing may be carried out as described above.

A half-silvered film will be produced in about a minute; only experience can determine when the proper thickness has been secured. The glass appears as though it were very lightly smoked. A film that reflects a little more than half the light incident at 45° is desirable for interferometer use. A simple method of testing is to look at two similar gas flames, one seen through the film and the other seen reflected by it. It is well to silver at once all four surfaces of the two plane-parallel plates of the interferometer and to select for use that film which is of the proper and most uniform thickness.

BRASHEAR PROCESS

[2]Two solutions are required, one, the reducing solution, should be prepared at least a week before it is used, and it may be made in large quantity and kept in stock with advantage; the other solution is to be prepared when used.

REDUCING SOLUTION

Distilled water	700 c.cm.
Pure sugar (loaf, granulated or rock candy)	80 g.
When dissolved add	
Alcohol	175 c.cm.
Strong nitric acid (sp. gr. 1.42)	3 c.cm.
Add water to make	1000 c.cm.

(*Continued on page 292*)

which gives good results at a temperature between 10° C. and 20° C. It is not unusually complicated, and the resulting coating is brilliant, comparatively hard, and adheres well to the surface of the glass. Coats of any thickness can be obtained by successive deposition. The layer can also be burnished for surface reflection.

IMPERFECTIONS

When the reflector is not near the focal plane small imperfections result only in a loss of light at the emergent pupil, and, although such a reflector may be slightly tarnished or spotted, the optical instrument may still be capable of performing its designed function.

When the silvered surface is in or near the focal plane, minute imperfections that ordinarily would be quite imperceptible may provide sufficient causes for the rejection of the instrument, especially when the power of the eye-piece is high.

Brown stains are usually attributable to impurity of the chemicals and want of cleanliness in conducting the operations and particularly the cleaning of the surface.

Pinholes in the silver which may be due to the evolution of gas bells or to the presence of dust, give rise in the course of time to systems of concentric rings which gradually broaden out. These tarnish rings have but little reflecting power, and are consequently very visible.

An unprotected silver layer on the surface of glass has very little durability. It rapidly tarnishes over the whole surface, and also is extremely liable to become spotted. It is essential that there should be as little time as possible between the silvering and protecting processes. The trouble may be due to atmospheric moisture containing acids associated with particles of dust in the air, which deposit themselves upon the silver surface. But the principal cause appears to be minute particles of saliva. From tests that have been carried out, it would appear that this substance reacts upon silver more quickly than dilute acids and alkalies. Perspiration also acts extremely rapidly on the silver, but a skilled operator exercises care in handling the silver surfaces, and is unlikely to suffer from such a source of trouble. If much time elapses between the silvering and the protecting processes, it is very difficult to prevent minute particles of saliva from landing on the surface. In one instance the number of rejections was greatly reduced by cutting out intermediate operations between the silvering and protecting operations, and thus reducing the time of exposure and the amount of handling. It will be understood that this applies to minute imperfections which under ordinary circumstances would be regarded as negligible.

Pinholes, when well defined, can be readily detected, but there is an intermediate type in which there is a local sponginess or possibly thinness of the layer. Pinholes or sponginess of this type cannot readily be protected by the electro-deposition of copper, as the pinhole in the silver will be reproduced in the copper as a spongy or thin area. It is not sufficient, therefore, to protect the surface by means of deposited copper without an additional protection of shellac or other varnish, because the coppered surface, if left exposed to the atmosphere, will probably become affected at this point of weakness.

CLEANSING OF THE GLASS SURFACE

A system that has been found satisfactory in practice when using the Brashear process is as follows:

The surface is first cleansed with naphtha, then with nitric acid. It is fortunate that the majority of the glasses in ordinary use are unaffected by strong nitric acid. The naphtha, like most solvents, leaves a fine residual film of oil on the

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BRASHEAR PROCESS

(*Continued from page* 291)

For silvering the mirror may rest face up on the bottom of a suitable dish; it may stand on edge, or be supported in any manner, face downward, dipping into the upper part of the solution. In the latter case, the mirror may be fastened with wax to a stick laid across the dish, or it may be supported on glass feet or on paraffined wood wedges. Dr. Brashear recommends that the mirror, if round, form the bottom of the silvering dish, which is completed by wrapping a strip of paraffined paper around the edge of the mirror, this being held in place by rubber bands or fastened with several wrappings of cord.

Having selected a dish and support for the mirror, measure with water the quantity of solution that will be required to make a layer a centimeter or two thick over the surface to be silvered. For each 150 c.cm. of final solution, 1 g. of silver nitrate and 0.5 g. of caustic potash (purified by alcohol) will be required. Dissolve the silver and potash separately, using quantities of water of the proportion of 100 c.cm. to 1 g. of the solid. Ordinary graduates or flasks are the most convenient form of vessel in which to mix the solutions. Into the silver nitrate solution pour a few drops of dilute aqua ammonia. The solution will turn to a dark brown color; add ammonia little by little till the precipitate is nearly but not quite redissolved. Now add the potash solution, when a precipitate will again be formed. This is to be nearly, but not entirely, redissolved by the addition of more ammonia, a few drops being sufficient this time. After the ammonia has been added shake or stir the solution well and wait a minute or two to be certain that it does not entirely clear. If by chance too much ammonia has been used, a little silver nitrate is to be dissolved and added, a few drops at a time, till a permanent precipitate is formed. This excess of silver must be present, the solution showing a decided brown tint. The solution may be filtered, though usually this is not necessary.

A quantity of reducing solution equal to about a twenty-fifth part of the solution just prepared is measured out. The mirror, having been properly cleaned and rinsed with distilled water, is placed in position. The reducing solution is poured into the silver and potash solution, and mixed by a quick shaking of the graduate or stirring with a glass rod; the whole is then poured into the dish. If the mirror is immersed face down, care is necessary to remove air bubbles; the mirror may well be immersed after the solution is in, being dipped in at one side first. If the mirror is at the bottom of the dish, after cleaning it is covered with a thin layer of water, and the prepared solutions are poured into the dish without further trouble. In the latter case the dish must be rocked during the time of deposition.

The solution soon turns to a black color, which in a few minutes will turn to a brown; and when it becomes a light gray and the precipitate is flocculent, which may be in ten or fifteen minutes, the operation is at an end. If the mirror is allowed to remain in the solution too long, the surface will have a bleached appearance, which polishing will hardly remove. Remove the mirror, rinse with water, and carefully wipe off the sediment with a tuft of absorbent cotton. It is then set on edge to dry; a rinsing with alcohol will facilitate the drying, or all water may be safely taken up by pressing clean blotting paper over the surface.

When dry, the surface may be polished, if necessary, with a small pad of chamois leather stuffed with cotton, on which is spread a little rouge. Small circular strokes of the pad, with light pressure, will soon bring out the deep luster of the silver.

A uniform temperature of the bath and the glass, of about 20° is essential to success.

Since fulminating silver is liable to be produced by the action of ammonia on silver oxide, especially in a warm room, all solutions should be thrown away as soon as the silvering operation is completed. The used solutions may be poured into a large jar, in which is thrown some common salt; this causes the silver to be precipitated as the chloride, and about 90 per cent of the original silver may be recovered.

surface, which is not removed by the nitric acid. The surface is, therefore, again cleansed with ammonia, followed by nitric acid, and finally by distilled water. It will be understood that the cleansing process should be carried out immediately before immersing the parts in the silvering bath.

When working the Rochelle salt process, after cleansing in the manner described above, the surface is immersed in a bath of stannous chloride, and then well washed in distilled water before insertion in the silvering bath. If there is delay between the stannous chloride treatment and the silvering process, the resultant coat will be unduly brown. The stannous chloride treatment appears to affect the brilliancy of the Brashear coat more than that of the Rochelle salt coat, and it is for this reason that it is not used in the Brashear process. Even in the Rochelle salt process the stannous chloride appears to have an effect upon the brilliancy of the coating. But it has the distinct advantage of producing a more adherent layer.

The action of the stannous chloride is somewhat obscure, and it would be interesting to have the opinions of the members of the Societies. I would suggest that the function of the stannous chloride is to provide a greater concentration of reducing agent directly on the surface of the glass where the deposit is desired than is obtainable from the ordinary liquids of the bath alone. It might be thought that the washing with distilled water would remove all the stannous chloride, but there is reason to believe that is not the case. After washing there appears to be an extremely thin surface film of stannous chloride, which can only be removed with some difficulty with nitric acid, but which is readily removed with hydrochloric acid.

SURFACE SILVERING

There are many cases in which surface silvering, either on glass or metal, would prove of great advantage, but at the present time it is hardly possible to make such surfaces sufficiently durable. It is well known that thin layers of varnish can be applied to such surfaces, the thickness of the layer when thin being so uniform as not to affect the definition under the highest magnifying powers that are customary. For example, if a drop of varnish composed of celluloid dissolved in amyl acetate and acetone is dropped centrally upon the reflector mounted upon a quickly rotating table, the varnish under centrifugal action will spread itself in a layer that is sufficiently uniform, provided it is very thin. A varnished surface of this type may appear uniformly colored when viewed obliquely.

Experiments which the writer carried out some time ago seemed to indicate that, although the layer could be thickened without at first affecting the definition, it tended to become granular or uneven, which is intelligible in view of the enormous contraction of varnishes of this type. Surface-silvered reflectors covered with various varnishes were exposed to the atmosphere, but not directly to the weather. As the atmosphere was that of Glasgow, the test was drastic. After three months the specimens showed signs of tarnishing and spotting. It was observed, however, that in the majority of cases the bulk of the tarnishing was near the periphery, from which it appeared to spread. In a new series which was prepared, the edges were sealed with a thick layer of gum damar varnish. After three months these specimens showed no signs of tarnishing; after six months there was slight spotting; when examined after nine months' interval there appeared to be a progressive increase in the tarnishing and the spots had grown, but it was estimated that the total amount of tarnishing would not have reduced the illumination by more than about 10 per cent. Some time later the specimens were stolen by some one who estimated the material value more highly than the scientific.

The results of the experiments seem to show that, even when the edges are sealed, surface silvering cannot be protected sufficiently well for practical commercial use.

Building Material Prices

In a conference between an investor, an engineer, an architect and a builder to decide whether to proceed with a certain project, the following tabulation of basic building material was used to show the position of prices today as compared with those of January 1919, January 1920, July 1921 and November 1921. This data comes from Dow's Daily Building Reports.

Material	Jan., 1919	Jan., 1920	July, 1921	Nov., 1921
Asphaltum, ton	$13.00	$30.00	$28.00	$22.00
Brick, Hud. Com., M	15.00	23.00	14.50	14.50
Cement, bbl.	*3.40	*3.40	†3.20	†2.90
Glass, A and B:				
Window, per cent off list	79	77	83-85	83
Plate, 5 sq. ft. or less	84	70	80	82
Plate, 5 sq. ft or over	84	70	82	78
Gravel, cu. yd.	3.50	3.25	4.25	2.65-2.80
Grit, cu. yd.	2.25	3.25	3.25	3.00-3.50
Hollow brick, M	15.00	20.00	25.00	25.00
Hollow tile (terra cotta) per M, N. Y., over 2 M sq. ft., 1½ x 12 x 12 split fur.	63.75	76.90	74.70	56.80
6 x 12 x 12 partition	153.00	160.00	179.40	151.60
Face brick:				
Harvards, M	45.00	48.00	50.00	45.00
Enam. Am. size white	75.00	100.00	145.00	125.00
Kittanning rough buff	50.00	52.00	54.00	50.00
Structural steel, per lb., mill	2.80c	2.47c	2.20c	1.50-1.65c
Angles	2.80	2.47	2.20	1.50-1.65
Lath-wire, wood, yd	.36	.35	.38	.39½
Lath-wire, iron, yd	.34	.35	.37	.39½
Lath, spruce, per M	6.50	20.00	10.50	11.50
Lime:				
Finishing, bbl.	3.70	4.00	*4.70	*4.70
Common, bbl.	3.50	3.80	*4.50	*4.40
Hydrate fin. cloth, per ton	23.50	27.00	28.00	26.00
Hydrate paper, per ton	22.50	23.00	26.00	24.00
Common hydrate cloth	21.25	23.50	22.50	22.50
Common hydrate paper	17.25	19.50	20.50	20.50
Lumber—white pine:				
Idaho C select 1 x 6	100.00	120.00	120.00	120.00
Yellow pine flooring:				
B-13/16 x 2½ in	85.00	160.00	87.50	95.00
B-13/16 x rift	75.00	140.00	65.00	75.00
Oak, 13/16 x 2½ clear qu. white	127.50	275.00	135.00	130.00
Maple, clear	77.50	145.00	105.00	115.00
No. 1	74.50	137.50	95.00	90.00
Yellow pine timber 3 x 6 to 6 x 6, 23 ft. under	57.50	75.00	50.00-55.00	50.00
Linseed oil, per gal.	1.48	1.83	.83	.75
Plaster:				
Neat wall, per ton, cloth	*20.00	*23.30	‡23.00	‡22.00
Finishing	*24.00	*25.00	‡26.00	‡26.00
Sand, per cu. yd.	2.25	1.80-1.90	1.60-2.00	1.65-1.80
Stone, crushed, cu. yd.	3.25	3.25	4.00	2.65-2.80

*Bag rebate 25 cents, 4 bags to barrel.
†Bag rebate 10 cents, 4 bags to barrel.
‡Bag rebates 15 cents.

The Laboratory

By J. B. KRAK

Colored Glasses

Colored glasses are obtained through the addition of metallic oxides or other chemicals to the batch. The coloring effect not only depends on the nature of the coloring agent but also on the state of oxidation, the quantity used, the temperature prevailing during the melting and fining processes and their duration. Slight variations in each one of these conditions may in some cases cause a radical change in the result. This is one of the principal reasons why batches for colored glass, published in the literature of the art, often appear to be faulty, and when tried out on a large scale are apt to cause trouble and may result in a total loss.

The coloring effect may be due to solution of the coloring agent in the glass, the intensity varying directly with the concentration. Or the color may be caused by the presence of innumerable minute particles, held in a state of suspension in the glass. In the latter case the color intensity depends mainly on the size and number of the particles.

Different shades may be obtained by adding more than one coloring agent. In this way practically every known variety and degree of color can be produced.

The number of substances which can be used as coloring agents is considerable as may be seen from the following table:

COLORED GLASSES AND CHEMICALS USED TO PRODUCE THEM

RED GLASSES.....	Cuprous oxide Gold chloride Selenium compounds
YELLOW GLASSES.....	Antimony Cadmium sulphide Sodium sulphide Cerium oxide Silver salts Ferric oxide Nickel oxide Organic substances
GREEN GLASSES.	Cuprous oxide Chromium compounds Ferrous oxide Uranium oxide
BLUE GLASSES.....	Cobalt oxide Copper oxide
VIOLET GLASSES.....	Manganese dioxide Manganese and cobalt oxides Nickel and cobalt oxides
BROWN GLASSES.....	Iron and manganese oxides Copper sulphide
GRAY GLASSES.....	Manganese dioxide and graphite Manganese, iron and copper oxides
BLACK GLASES.....	Iron oxide Manganese dioxide Chromium oxide Uranium dioxide Cobalt oxide Basalt
WHITE GLASSES.....	Calcium phosphate Cryolite Magnesium silicate Calcium fluoride

Coloring agents, bought in the open market, often contain impurities which may modify the shade of color. For this reason some manufacturers prefer to make their own colors from chemically pure materials. The following methods of preparing some of the well-known colors may serve as examples.

IRON OXIDE

Dissolve pure ferrous sulphate, also known as sulphate of iron, copperas, green vitriol or iron vitriol, in water to which a few drops of sulphuric acid have been added. Filter if necessary and add ammonia in slight excess. Filter the precipitate of ferrous hydrate, wash a few times with water and allow to dry. During the drying process the color changes from grayish-green to brown due to absorption of oxygen from the air. Transfer the material to an iron pan and heat over an open flame to a dull red heat. This procedure leaves the iron oxide as an extremely fine powder.

Another method of preparing pure iron oxide is as follows: To the solution of ferrous sulphate add a solution of sodium oxalate until no further precipitate is formed. Filter, wash, dry and ignite. The reddish brown powder thus obtained is especially adapted to polishing fine optical glass on account of its very fine state of division. It is designated as jewelers' rouge.

NICKEL AND COBALT OXIDES

Dissolve the chloride, nitrate or sulphate of nickel or cobalt in water and add a dilute solution of pure caustic soda. Filter, wash, dry and ignite gently.

COPPER OXIDE

Dissolve pure copper vitriol, also known as sulphate of copper, blue stone, blue copperas or blue vitriol, in hot water. Heat to boiling and add a solution of pure caustic soda. The blue, voluminous precipitate rapidly changes to a heavy black substance which is filtered, washed and dried. It may be used without being ignited.

CHROMIUM HYDROXIDE

Fuse one part of potassium bichromate with three parts of borax. Digest the fused mass with water. A green powder remains which is filtered, washed and dried. This compound dissolves much easier in glass than chromium oxide and gives more uniform results.

SILVER COMPOUNDS

Dissolve pure metallic silver in nitric acid, evaporate down and add water. Evaporate again and allow the crystals of silver nitrate to form slowly. If silver chloride is desired, dissolve the nitrate in water and add a solution of common salt. Wash with water, filter and dry. The silver chloride should be protected from direct sunlight.

GOLD CHLORIDE

Dissolve pure gold in a mixture of one part of nitric acid and three to four parts of hydrochloric acid (aqua regia). On

account of the formation of poisonous chlorine gas, the work should be done in the open or under a hood with a strong draft. Evaporate the solution to a small volume, add hydrochloric acid and water and evaporate again.

Iron compounds impart a green or a yellow color to glass. Ferrous iron colors a lime-potash glass a greenish-blue tint, a lime-soda glass a bluish-green and a lead glass a yellowish-green. Ferric iron gives a lime-soda glass a greenish-yellow tint, a lime-potash glass a yellowish-green and in a lead glass it produces a yellow-green color. Iron is used in connection with manganese to make brown or amber-colored glass, used for bottles. It is also used in small quantities to modify other colors.

Manganese compounds produce wine red, violet and black colors, which develop least when oxidizing conditions prevail. Reducing substances alter the intensity of the color and may cause it to disappear completely. In lead or soda-lime glasses the color is a reddish violet. Potash-lime glasses take an amethyst color. A small amount of cobalt oxide is sometimes used to improve the coloring effect.

Copper compounds are used to produce bluish green, pale blue and red glasses. Cuprous and cupric oxide, and to some extent copper vitriol, are used. Absence of iron is essential to obtain the desired shades of color. When copper oxide is added to the glass under reducing conditions metallic copper is precipitated and held in colloidal suspension, producing what is called "aventurine." It is important to maintain reducing conditions throughout the process. This is accomplished by adding finely divided tin, tin oxide or bichloride often. Organic substances are also used to effect reduction.

Cobalt compounds are used to obtain blue colors, in all varieties of glass, ranging from a pale blue to the darkest ultramarine. The coloring effect of cobalt is so great that a slight error in weight may change the color intensity to a large degree. For this reason smalt or powdered blue is preferred. This substance is a cobalt glass, made by heating cobalt oxide with sand and potash. The fused mass is cooled quickly and ground to a fine degree beneath water. It contains from 3 to 6 per cent cobalt oxide.

On account of the low percentage of coloring matter in powdered blue any inaccuracy in weighing has not the effect of a similar error in adding pure cobalt oxide. However, since one part of cobalt can color 250 parts of glass it is important to know the strength of smalt, and it is advisable to buy this material with a guaranteed analysis from a reliable dealer.

Chromium compounds: Yellow to green colors can be obtained with chromium, depending on the composition of the glass. In soda-lime glass the color is green, in potash-lime glass it is yellowish-green. Chromium oxide, potassium bichromate and potassium chromate are used most frequently. Sometimes the chromates of barium, zinc and lead are preferred. Colors produced by chromium are little affected by reducing or oxidizing conditions in the furnace. Chromium oxide is only slightly soluble in glass and if an excess is used so-called chromium aventurine is formed through the separation of chromium oxide in minute crystals. The color due to chromium is usually modified by addition of other coloring agents, especially copper oxide.

Uranium compounds: Uranium is used as the dioxide, a black powder, for the manufacture of black glass. The trioxide, sodium uranate, uranyl nitrate, phosphate and acetate impart a yellowish-green color to soda-lime glasses and a beautiful yellow fluorescent color to potash-lime glass. In reflected light this color is green. The coloring power of uranium is very great, one per cent of this element being sufficient to obtain a strong coloring effect.

Silver compounds: Metallic silver is soluble in glass but the solubility is so small that most of the metal is separated out on cooling. In order to color glass with silver, it is necessary to apply the silver compound to the surface of the glass in small quantities as a stain. The glass is then heated to about 400° C. and starts to absorb the silver slowly. At about 800° C. the silver salt is decomposed and the silver is separated in colloidal suspension, producing a beautiful yellow color. Only the surface takes on the color due to this metal. Besides the nitrate and chloride, silver borate and chromate are used. The latter produces a greenish-yellow glass.

Gold compounds: Gold is added to the batch as the chloride. The solution is sprinkled over a small amount of sand and allowed to be soaked up thoroughly. The sand is then uniformly mixed with the batch. Slow cooling and frequent reheating is necessary to develop the rose-ruby tint due to colloidal suspension of metallic gold particles. No reducing agent is necessary.

Instead of gold chloride the so-called Purple of Cassius is sometimes used. This compound is obtained by adding a mixture of the two chlorides of tin to a solution of gold chloride. The resulting precipitate contains finely divided metallic gold and stasmic acid. It was first used on a large scale by Kunkel. Selenium is used as metallic selenium but sodium or calcium selenate are preferred, as these compounds are less volatile than the element. It produces a rose-red color which is especially beautiful in glasses containing barium.

Sulphides can only be used in glasses free from lead, since lead under reducing conditions would cause a black color due to separation of the metal. Glass made with salt cake can be given a yellow color by adding carbon in the form of charcoal, graphite or anthracite. Sugar is sometimes used as a reducing agent. A yellow color is produced due to the formation of sodium sulphide. Cadmium sulphide causes an intense yellow color in glass. Compounds of titanium, molybdenum, tungsten and cerium are used to a small extent in the production of yellow glasses. Manganese dioxide in large quantity, either alone or mixed with cobalt oxide and copper oxide, yields a black glass. A gray color may be obtained by using a mixture of copper, iron and manganese compounds or of sodium uranate, mixed with the oxides of cobalt and nickel.

WHITE AND OPAQUE GLASSES

The composition of white and opaque glasses was discussed in Vol. 2, No. 4 (April, 1921), pages 81-84.

THE ILLUMINATING ENGINEERING SOCIETY has voted to adopt the term "luminaire" to describe a lighting unit.

The Glass Industry

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ADVERTISING RATES ON APPLICATION

NEW YORK, DECEMBER, 1921

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Geological Survey Bulletin on Gypsum

GYPSUM DEPOSITS IN THE UNITED STATES, by R. W. Stone and others. Bulletin 697, United States Geological Survey, 326 pages. Size 5¾ by 9¼ inches. Price 50 cents. For sale by the Superintendent of Documents, Washington, D. C.

Includes a discussion of the mineralogy and geology, chemical and physical properties, varieties and classifications of gypsum, an historical account of the gypsum industry, data on production, technology and uses, and other matter. Also a compilation of analyses of gypsum from different localities, and an article by George Steiger on Errors in the Analysis of Gypsum.

The Turning Point

Throughout the country there is a growing sentiment that the turning point in the business depression has been reached and that America again is headed toward a period of prosperity. There are undoubtedly several signs pointing towards better times. The report of the Steel Corporation for the third quarter of the year shows an upward trend of profits during August and September. The price of oil is increasing; the copper and rubber markets are showing firmness. There is considerable building activity, crops have been abundant, foreign exchange rates of our former allies are recovering, money rates are decreasing. In many ways a gradual improvement is noticeable.

The general condition of the world, however, is still decidedly unsatisfactory, and it is difficult to see how permanent prosperity can return, unless most of the disturbing factors affecting worldwide business conditions have been eliminated. Trade is international and reciprocal. We cannot have a business revival of our own. As long as vast numbers of people are actually suffering hunger and great nations are entirely disorganized it is folly to expect a return to normal times.

It is with high hopes and with great expectations that the world is watching the Washington Conference on reduction of armaments. Nothing could do more to restore the normal currents of trade and the extension of general welfare than a removal of the constant threat of war which, like the sword of Damocles, ever hangs above our heads. Only a rigid curtailment of government expenses will enable the nations to liquidate their obligations. The problems before each individual country are great; the problems to be solved by the world as a unit are staggering to the imagination and no satisfactory solution is possible unless through cooperation.

To this end America has resolutely set its face. May the Washington Conference bring us the peace for which the world is yearning.

Journal of the American Ceramic Society

The August number of the *Journal of the American Ceramic Society* contains the following articles:

THE CAUSES AND CONTROL OF FISH SCALING OF ENAMELS FOR SHEET IRON AND STEEL, by R. R. Danielson and W. H. Souders, of the United States Bureau of Standards.

CORDS AND SURFACE-MARKING IN GLASSWARE, by F. E. Wright, of the Geophysical Laboratory, describes a method of distinguishing between surface-marking and cords by immersing the piece of glass under test in a liquid of the same refringence and sighting through liquid and glass toward a distant light. Under these conditions, surface-markings disappear altogether. Cords, on the other hand, stand out more distinctly than before. The relative refringence of a cord compared with that of the adjacent glass can also be determined at the same time.

ZIRCONIA CEMENTS, by Mark Sheppard, of the Mellon Institute of Industrial Research.

THE APPLICATION OF PRODUCER GAS TO PERIODIC MUFFLE KILNS, by F. B. Ortman.

CONTINUOUS TUNNEL KILNS AT THE PLANT OF MOUNT CLEMENS POTTERY COMPANY, by C. B. Harrop.

This issue contains 78 abstracts and a review of Alfred B. Searle's book entitled "Modern Brick-making," appearing in its second edition.

The September number of the *Journal* contains the following articles:

SOME RELATIONS OF COMPOSITION TO SOLUBILITY OF ENAMELS IN ACIDS, by Homer F. Staley of the U. S. Bureau of Standards.

HIGH FIRE PORCELAIN GLAZES, by H. H. Sortwell of the U. S. Bureau of Standards.

A TERRA COTTA INDUSTRY FOR OHIO, by Arthur S. Watts.

A STUDY OF THE OPERATION OF A DRESSLER TUNNEL KILN, by Charles J. Hudson of the Norton Company.

HIGH TEMPERATURE TESTING FURNACE, by W. M. Hepburn, of the Surface Combustion Company.

REFRACTORIES UNDER LOAD CONDITIONS, by H. J. Knollman, of the Abrasive Company.

The issue contains 62 abstracts of recent articles published in English, French and German.

Journal of the Society of Glass Technology

The October number of the *Journal of the Society of Glass Technology* contains the following articles:

THE DEVELOPMENT OF VARIOUS TYPES OF GLASS, by C. J. Peddle. Parts XII-XVI inclusive. The Interaction of Silica Sodium Oxide and Barium Oxide. The Interaction of Silica Potassium Oxide and Barium Oxide. The Interaction of Silica Barium Oxide and the Oxides of Sodium and Potassium. A Comparison of the Alkali-Barium Oxide-Silica Glasses. A Comparison of the Alkali-Barium-Silicate and Alkali-Lead Silicate Glasses.

THE SHRINKAGE, POROSITY, AND OTHER PROPERTIES OF BRITISH FIRE CLAYS AFTER BEING FIRED AT HIGH TEMPERATURES, by Edith M. Firth and W. E. S. Turner.

THE DENSITY OF GLASSES CONTAINING ALUMINUM, by S. English and W. E. S. Turner.

THE HEAT BALANCE OF A PLANT CONSISTING OF AN AIR-STEAM BLOWN GAS PRODUCER AND A GLASS TANK FURNACE, by M. W. Travers.

THE APPLICATION OF OIL FUEL IN THE GLASS INDUSTRY. General Discussion.

Oil as a Fuel for Glass Furnaces, by Joseph Connolly.

The Relative Efficiency of Gas and Oil Firing in Glass Furnaces, by M. W. Travers.

Fuel and Its Application, by J. V. Stevens.

Oil Fired Glass Furnaces, by A. F. Baillie.

The number contains 98 Abstracts of recently published articles.

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility THE GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to submit them.

Answers to all questions will be made by mail as promptly as possible. The source of all inquiries will be held in strict confidence.

QUESTION 14.—We are mailing a sample of glass under separate cover. Will you kindly tell us whether it is properly annealed?

ANSWER.—The sample of glass recently submitted for examination was referred to a laboratory which reports that the glass shows both strains and laminations, but the strains do not show up very prominently. It may be stated, therefore, that while the annealing is not perfect, it is quite satisfactory.

We would suggest that, if in the future, you should submit any samples of this thickness, they should be sent with parallel and polished surfaces. Samples like bottles or plain tableware can easily be cut with a diamond, and thus parallel surfaces obtained, but the sample submitted was of such a nature that it had to be ground and polished.

QUESTION 15.—Has any data been published showing Ohms per degree Fahrenheit of the relative electro conductivity of glass from the solid to the molten stage.

Can any reader favor the inquirer with this information?

New Glass Container Periodical

The first number of *The Glass Container*, the new monthly organ of the Glass Container Association of America, has made its appearance and proves to be an attractive and interesting 40-page publication bearing the stamp of quality in both editorial matter and physical make-up. Numerous articles relating to various phases of the glass container and packing industries are presented, including the following: Discussion of Inauguration of G. C. A. Traffic Bureau, by John Welch, vice-president Welch Grape Juice Company; A Note on the Development of the Glass Industry, by Dr. R. R. Shively, chief chemist, Monongah Glass Company; Shore Dinners in Oklahoma—Glass Packed, by G. P. Nelson; the first of a series of historical articles on Glass Making, by Dr. A. W. Bitting, director of research, Glass Container Association; an account of the origin and aims of the Glass Container Association; the Purpose of the National Food Packers Traffic Association.

The purpose underlying the establishment of the new periodical is the encouragement of co-operation between the makers and users of glass containers. In introducing itself *The Glass Container* says editorially:

> "With the publication of this issue *The Glass Container* makes its bow to all users of glass containers: to those firms who are already committed to the packing of their products in glass, and to those who may in time come to appreciate the value of the transparent package. Its real audience is, then, the great body of users.
>
> "One paramount task was imposed upon *The Glass Container* when it was called into being by the Association: the task of serving faithfully the packers in glass, and so fostering the growth of good-will between these two closely allied industries—the makers of the package and the makers of the contents. How closely associated they are, how inseparably the fate of one is bound up in that of the other, is probably not at present fully appreciated. It is to bring this essential fact home to both industries that this magazine exists."

In a message to the users of glass containers, C. J. Root, president of the Glass Container Association of America, writes:

> "Business, we read, is a cold proposition—but need it be? Today, as never before, American business has come to a true appreciation of the need of friendly contact and good-will for its permanent development.
>
> "To bring about this favorable relationship between the glass container industry and its customers, it is first necessary to substitute for that feeling of diffidence which so often divides one business group from the others with which it deals, an attitude of mutual confidence and trust. We hope *The Glass Container* will serve this wholesome purpose."

The Glass Container is to appear monthly from the offices of the Association at 70 Fifth Avenue, New York. Judge I. G. Jennings is directing editor, Dr. A. W. Bitting, director of research, and Ralph S. Richmond is editor.

The officers of the Association for the current year are: president, C. J. Root, Root Glass Company, Terre Haute, Indiana; 1st vice-president, I. R. Stewart, Anchor Cap & Closure Corporation, Long Island City, New York; 2nd vice-president, E. B. Ball, Ball Brothers Glass Manufacturing Company, Muncie, Indiana; secretary, H. J. Booth, C. L. Flaccus Glass Company, Pittsburgh, Pa.; treasurer, R. E. Walker, Turner Brothers Company, Terre Haute, Indiana.

The advent of *The Glass Container* into the publishing field is welcomed by THE GLASS INDUSTRY, which extends its congratulations to the Glass Container Association and expresses its sincere and hearty wishes for the fullest possible measure of success for the new enterprise.

First Detailed Production Statistics, 1920 Census

Tabulated from the Supplemental Schedules for the Glass Industry Under the Direction of

W. M. STEWART, Director, Bureau of the Census

A preliminary summary issued by the Census Bureau giving the general results of the Census of 1920 covering the glass industry for the year 1919 was published in the May, 1921, number of THE GLASS INDUSTRY. It is now possible, through the courtesy of the Director, W. M. Stewart, of the Bureau of the Census, to put before the trade the detailed production figures for all kinds of glass and glassware, also the value, by states, of building glass, pressed and blown ware, bottles and jars and miscellaneous glass factory products.

The number of pot furnaces and tanks in operation and idle in 1919 is also shown and compared, as are the production figures also, with the returns made for the years 1914, 1909 and 1904. One of the most striking facts shown by the comparative figures is the remarkable increase in the value of all glass products

Total Production of Glass and Glassware in 1919

	1919	1914	1909	1904
Products, total value	$261,884,080	([1])$123,085,019	([1])$92,095,203	([1])$79,607,998
Building glass, value	$83,713,115	$36,824,069	$26,308,438	$21,697,861
Window glass—				
Square feet	368,912,209	400,998,893	346,080,550	242,615,750
Value	$41,100,724	$17,495,956	$11,742,959	$11,610,851
Obscured glass, including cathedral and skylight—				
Square feet	33,822,302	43,040,079	22,815,946	21,870,634
Value	$4,300,308	$2,417,253	$1,358,574	972,014
Plate glass, total cast, square feet	72,849,340	75,770,261	60,105,694	34,804,986
Polished—				
Square feet	56,823,749	60,383,516	47,370,254	27,293,138
Value	$33,348,279	$14,773,787	$12,204,875	$7,978,253
Rough, made for sale—				
Square feet	788,742	131,492	205,690	17,784
Value	$171,118	$25,859	37,431	$3,529
Wire glass—				
Polished—				
Square feet	1,229,077	1,707,848	([2])	([2])
Value	$635,543	$534,322	([2])	([2])
Rough, made for sale as such—				
Square feet	14,462,409	13,980,996	([2])	([2])
Value	$2,271,099	$1,056,612	([2])	([2])
All other building glass, value	$1,886,044	$520,280	$964,599	$1,133,214
Fressed and blown glass, value	$70,748,861	$30,279,290	$27,398,445	$21,956,158
Tableware, 100 pieces	2,457,938	1,554,056	1,286,056	1,283,974
Jellies, tumblers, and goblets, dozens	25,182,133	18,030,243	11,687,036	7,346,214
Lamps, dozens	917,250	580,196	322,482	487,017
Chimneys, dozens	6,615,109	6,989,624	6,652,967	7,039,756
Lantern globes, dozens	1,985,741	1,363,562	952,620	1,765,247
Shades, globes, and other gas goods, dozens	12,313,307	2,016,800	1,541,449	878,244
Blown tumblers, stemware, and bar goods, dozens	9,668,638	11,377,310	9,182,060	6,282,606
Opal ware, dozens	2,155,972	4,636,051	3,095,666	1,091,208
Cut ware, dozens	549,170	297,957	206,336	83,736
Decorated glassware, dozens	1,052,851	1,158,077	([2])	([2])
Lenses, dozens	725,675	([2])	([2])	([2])
Electric bulbs, dozens	18,363,603	([2])	([2])	([2])
Tubing, pounds	18,147,470	([2])	([2])	([2])
Bottles and jars, value	$94,670,389	$51,958,728	$36,018,333	$33,631,063
Prescriptions, vials, and druggists' wares, gross	6,684,548	4,893,416	3,624,022	3,202,586
Beer, soda, and mineral, gross	4,178,368	4,573,610	2,345,204	2,351,852
Liquors and flasks, gross	993,030	2,689,022	1,887,344	2,157,801
Milk jars, gross	877,268	1,188,891	440,302	253,651
Fruit jars, gross	1,860,262	1,198,952	1,124,485	1,061,829
Battery jars and other electrical goods, gross	13,805	79,211	9,981	19,974
Patent and proprietary, gross	3,364,679	1,384,689	1,637,798	1,657,372
Packers' and preservers', gross	4,297,076	3,271,174	1,237,175	1,237,065
Demijohns and carboys, dozens	271,119	160,796	122,570	64,450
All other products, value	$12,751,715	$4,022,932	$2,369,987	$2,322,916

[1]In addition, considerable quantities of electrical shades, globes and bulbs, which cannot be shown without disclosing the operations of individual establishments, were made in 1914 by establishments engaged primarily in the manufacture of electrical goods. In 1909, 42,639 gross of bottles and jars, valued at $90,490, and in 1904 glassware, valued at $9,663, were made as subsidiary products by establishments engaged primarily in other lines of manufacture.

[2]Not reported separately.

between the years 1914 and 1919 due, of course, to the heavy demand, difficulties of production and the increase in production costs resulting from the war. Less window glass, obscured plate and wire glass was made in 1919 than in 1914 but the total value of the 1919 production in each case was much higher than in 1914, in some cases several times as high.

In pressed and blown glass the most noticeable gain in production was that of "shades, globes and other gas goods," which increased about 500 per cent over the 1914 production. It is interesting to compare the 1919 production in this line—12,313,307 dozen—with the quantity made in 1904, 15 years earlier, when only 878,244 dozen were produced. Opal ware production in 1919 was less than half as great as in 1914, and blown tumblers, stemware and bar goods also showed a considerable decline. In spite of the large increase in the quantity of lighting goods manufactured in 1919, the production of lamp chimneys held its own quite well. Cut glass returns show a large gain in production. A big decline in liquor bottles and flasks was offset by a heavy gain in the production of patent medicine and proprietary ware.

The total value of all glass products in 1919 was $261,884,080 compared with $123,085,019 in 1914, and $79,607,998 in 1904.

In 1914, 26 establishments reported 106 tanks equipped with 331 automatic machines; five years later in 1919, 71 establishments reported 161 tanks equipped with 640 automatic machines of various types.

Total Production of Glass and Glassware in 1919 by States

	1919	1914	1909	1904
Products, total value	$261,884,080	$123,085,019	$92,095,203	$79,607,998
Illinois	18,244,717	7,680,343	5,047,333	5,619,740
Indiana	30,106,652	14,881,372	11,593,094	14,706,929
Kansas	2,133,470	728,681	2,036,573	958,720
Maryland	4,031,841	1,500,982	1,038,368	598,589
Missouri	6,927,042	3,882,420	1,992,883	1,781,026
New Jersey	13,694,677	7,597,754	6,961,088	6,450,195
New York	12,995,741	5,156,714	4,508,790	4,279,766
Ohio	35,240,877	19,191,342	14,358,274	9,026,208
Oklahoma	4,750,844	2,005,736	(1)	(1)
Pennsylvania	80,479,752	39,797,822	32,817,936	27,671,693
Virginia	831,455	690,420	681,900	549,031
West Virginia	42,730,338	14,631,171	7,779,483	4,598,563
All other states	9,716,674	5,340,262	3,279,481	3,376,538
Building glass, value	$83,713,115	$36,824,069	$26,308,438	$21,697,861
Illinois	(1)	(1)	648,718	281,559
Indiana	5,485,490	2,356,946	1,616,092	3,790,618
Kansas	1,833,470	(1)	1,131,808	381,048
Missouri	(1)	3,122,793	1,778,364	1,036,433
New Jersey		(1)	(1)	201,922
New York	(1)	(1)	173,387	456,310
Ohio	7,204,826	3,805,669	2,744,513	1,625,126
Oklahoma	(1)	1,181,657	(1)	(1)
Pennsylvania	39,613,933	18,968,873	14,958,649	12,169,013
West Virginia	15,217,616	4,410,710	2,751,133	1,323,896
All other states	14,357,780	2,977,421	505,774	431,900
Pressed and blown glass, value	$70,748,861	$30,279,290	$27,398,445	$21,956,158
Indiana	6,656,007	2,926,296	2,774,128	2,859,087
Kansas		(1)	202,696	64,697
Maryland	(1)	(1)	508,492	46,191
New Jersey	3,108,505	(1)	1,019,836	181,559
New York	7,135,823	2,237,960	1,926,852	1,932,524
Ohio	16,740,016	6,490,498	6,160,707	3,954,660
Oklahoma	890,001	220,520	(1)	.....
Pennsylvania	20,923,793	11,241,495	9,847,228	9,406,183
West Virginia	12,943,426	6,263,554	4,306,528	2,620,665
All other states	2,351,290	898,967	651,978	890,592
Bottles and jars, value	$94,670,389	$51,958,728	$36,018,333	$33,631,063
California	(1)	(1)	873,434	855,446
Illinois	14,419,392	6,680,700	4,304,795	4,949,156
Indiana	17,126,052	9,155,163	6,982,378	7,213,456
Kansas	.....	(1)	651,376	407,868
Maryland	3,427,575	1,244,760	528,767	536,478
Missouri	(1)	759,627	(1)	607,383
New Jersey	10,457,863	7,176,787	5,884,605	6,065,714
New York	4,473,507	2,343,683	1,884,394	1,866,245
Ohio	8,579,661	7,422,402	4,717,658	2,961,727
Oklahoma	2,382,532	603,559	(1)	(1)
Pennsylvania	15,120,155	8,930,255	7,778,787	5,951,144
Virginia	825,755	690,420	681,900	549,031
West Virginia	13,069,308	3,777,445	646,521	602,002
All other states	4,788,589	3,173,927	1,083,718	1,064,413
All other products	$12,151,715	$4,022,932	$2,369,987	$2,322,916

(1) Included in "all other states," to avoid disclosing the operation of individual establishments.

Furnaces and Tanks in Operation and Idle in 1919

State	Census year	Pot furnaces				Tanks (1)							
						Continuous				Intermittent			
		Operated		Idle		Operated		Idle		Operated		Idle	
		Number	Number of pots	Number	Number of pots	Number	Number of rings	Number	Number of rings	Number	Capacity (tons)	Number	Capacity (tons)
United States	1919	289	4247	41	567	437	3073	47	300	116	386	9	25
	1914	328	4522	58	766	348	3641	48	421	59	467	16	94
	1909	370	4945	59	697	369	3759	48	436	73	433	13	56
	1904	349	4192	49	617	340	3076	26	191	94	406	13	69
Illinois	1919	7	120	..	...	26	98	3	16	...	...	..	..
	1914	6	100	2	30	18	101	2	23	...	...	1	2
	1909	9	107	1	20	24	201	4	53	1	5	..	..
	1904	8	104	4	47	24	284	..	...	4	20	1	10
Indiana	1919	16	220	1	10	55	312	2	14	3	13	..	..
	1914	18	244	2	22	57	499	5	21	3	19	..	..
	1909	18	307	2	40	61	533	6	34	2	14	..	..
	1904	63	670	7	79	87	749	4	25	3	20	1	8
Maryland	1919	8	100	1	12	6	19	..	...	4	17	..	..
	1914	6	84	1	16	4	23	..	...	1	12	..	..
	1909	11	109	1	12	3	21	..	...	1	8	..	..
	1904	6	74	2	17	1	5	..	...	1	8	..	..
New Jersey	1919	14	116	6	49	34	207	5	40	12	37	3	9
	1914	15	115	2	19	27	257	15	117	5	27	3	18
	1909	16	130	6	42	36	329	12	90	9	106	1	11
	1904	19	147	4	36	35	310	11	71	11	60	..	..
New York	1919	26	311	5	38	21	141	1	..	3	8	3	9
	1914	23	281	6	45	15	117	4	23	2	4	1	2
	1909	35	798	9	66	19	167	1	7	3	7	1	1
	1904	28	257	3	27	22	179	2	15	3	10	1	6
Ohio	1919	50	819	10	190	54	333	7	85	5	20	1	3
	1914	58	759	7	101	36	519	5	96	7	26	..	..
	1909	56	593	12	143	49	434	8	98	11	27	2	3
	1904	39	551	4	69	34	283	2	20	12	33	2	9
Pennsylvania	1919	102	1669	12	180	95	663	14	72	51	116	..	..
	1914	138	2121	28	383	90	1011	10	100	28	282	5	57
	1909	144	2086	23	301	99	1178	12	93	26	145	6	27
	1904	120	1715	17	222	87	864	6	54	36	137	3	12
West Virginia	1919	40	494	3	36	93	721	6	40	35	160	2	4
	1914	32	341	2	20	54	615	4	26	12	95	4	9
	1909	37	339	2	24	33	422	2	45	12	96	2	11
	1904	43	393	6	88	18	155	1	6	19	90	5	24
All other states	1919	26	398	3	52	53	579	9	33	3	15	..	..
	1914	32	477	8	130	47	499	3	15	1	2	2	6
	1909	44	476	3	49	45	474	3	16	8	25	1	3
	1904	23	281	2	32	32	247	..	..	5	28	..	..

(1) In addition, 71 establishments reported, for 1919, 161 tanks equipped with 640 automatic machines; in 1914, 26 establishments reported 106 tanks equipped with 331 automatic machines.

Wholesale Indictments of Window Glass Manufacturers

As a result of the Lockwood investigation last summer into building trade conditions in New York City, a Federal Grand Jury on November 28th returned to Federal Judge Augustus W. Hand an indictment charging approximately two-thirds of the window glass manufacturers of the country with entering a conspiracy in restraint of trade in violation of the Sherman Anti-Trust laws. The indictment names 104 separate defendants, including fifty-three corporations and fifty individuals who, as officers, are connected with these corporations, as well as Joseph M. Neenan, of Cleveland, O., who was until recently president of the National Window Glass Workers' Union.

This is the largest number indicted for Sherman Anti-Trust law violations since the original packer and Standard Oil cases. The charges result from an investigation conducted since last August, under direction of Colonel William Hayward, United States Attorney, and David L. Podell, Special Government Counsel.

The investigation by the Federal authorities followed testimony given before the Lockwood committee in the building trades inquiry to the effect that the price of plate and window glass had been increased from 200 to 300 per cent during the period of the war. The defendants named in the indictment have an aggregate capitalization of $200,000,000, and their aggregate volume of business is approximately $100,000,000 a year.

The charge against all the defendants is that they combined to eliminate competition, to fix prices, to limit production and supply, and to control shipment and delivery of window glass into the southern district of New York and other parts of the country. They are accused of having maintained a common selling agent with headquarters in Pittsburgh, and a branch office in New York City. All the defendants are cited to appear in court for an early hearing.

Want Carload Minimum Reduced

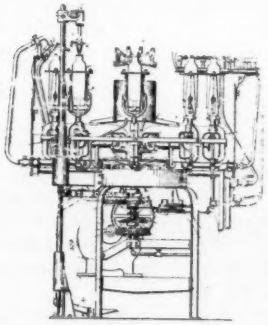
The Southern Sash, Door and Millwork Association at its November convention at Atlanta, Ga., elected officers for the ensuing year, and passed a resolution to be presented to the Interstate Commerce Commission calling for the reduction to the former minimum of 36,000 pounds per carload for window glass. R. S. Wessels of the Pittsburgh Plate Glass Company, Atlanta, and other speakers addressed the meeting.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of the Patent Specifications mentioned below may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c. each.

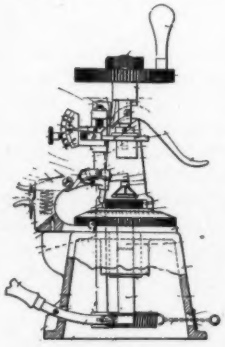
Method of and Apparatus for Manufacturing Glassware. U. S. 1,390,626, Sept. 13, 1921. Erick P. Leindahl, of Cincinnati, Ohio, Assignor to the Icy-Hot Bottle Company of Cincinnati Ohio.



It is the object of this invention to provide a new and improved method whereby to connect proximate pieces of glass and apparatus to be used in connection therewith. The invention is applicable for connecting the inner and outer walls of a frangible double-walled vessel, employable for instance in vacuum containers, such as vacuum insulated bottles, carafes, and the like.

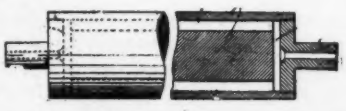
It is the object of this invention further to provide a new and improved method whereby the walls to be connected are centered, so that the ends to be connected, instanced as the mouth ends of the walls, are caused to rotate in concentric paths, and to so relate the edges and cause their rotation in the presence of heat that centrifugal force preferably acting in conjunction with gravity causes an automatic juxtaposing of the edges to be connected, the edges being then fused while rotating in the presence of heat for making a hermetic seal at the joint thus formed.

Lens-Cutting Machine. U. S. 1,388,774. Aug. 23, 1921. Walter W. Slade, of Brookline, Mass., assignor to Globe Optical Co., of Boston, Mass., a corporation of Massachusetts.



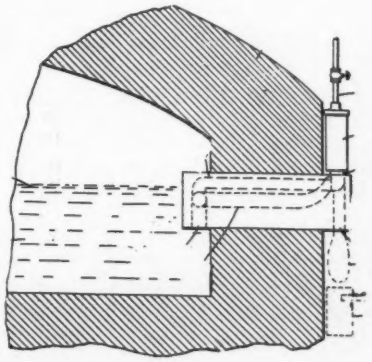
This invention relates to a lens cutting machine as illustrated, consisting of a work holder, having a cutter, means to secure angular adjustment between the cutter and the holder. The holder being pivotally mounted to be swung into or out of operative position, and a pivoted cam lever, operable to swing the work holder while having its cutter in adjusted position, out of operative position. The lever having a two-faced bearing surface in contact with the support and in a position relatively with its pivot to hold the support locked in outward position.

Water-Cooled Glass-Roller. U. S. 1,392,626. Oct. 4, 1921. Walter Cox, of Philadelphia, Pa.



This invention relates to a water-cooled glass roller consisting of a metal cylinder having a circular row of spaced parallel water channels extending axially through its body and arranged near its surface and providing between and around them a metal core and solid metal supports and having at the ends inlet and outlet water connections communicating with said channels in multiple.

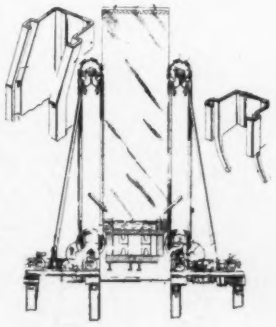
Glass Discharging Mechanism. U. S. 1,391,957. Sept. 27, 1921. Edward S. Hutton, of Lapel, Indiana.



This invention relates to a glass discharge apparatus in a glass tank for conveying the molten glass from the interior of the tank and discharging the same in a gather into a mold.

The object of this invention is to provide a simple discharging apparatus which will always function and keep itself automatically cleaned of chilled glass and will avoid the troubles arising from a glass discharge apparatus where the outlet is closed or controlled by a plunger or other stopping means which is liable to become "stuck" by reason of the chilling of the glass, and which requires considerable time and trouble to heat and melt the chilled glass therein after the device has become cold from non-use and preliminary to starting the tank again.

Sheet Glass Drawing Machine. U. S. 1,393,081. October 11, 1921. Robert P. Callard and Clarence A. Rhonemus, of Charleston, West Virginia, assignors to the Libbey-Owens Sheet Glass Company.



This invention relates to the art of drawing sheet glass and is designed as an improvement on the structure shown and described in the claims of the application of Clarence A. Rhonemus, Serial No. 291,214, filed April 19, 1919, in which a suitable glass-receiving tank or pot is provided, with oppositely disposed overflow portions, the overflow from which is received by slotted, vertically moving tubular portions to overcome the narrowing tendency of the sheet and to assist in the drawing operation.

By the present invention, there is substituted for said vertical tubular members a continuous series of tubular or cup-shaped portions, provided with means for placing the same end to end and moving them past the overflow portions of the pot, suitable slots or openings being provided for receiving said overflow.

Glass Roll. U. S. 1,394,684. October 25, 1921. Kenji Matsuo, of Tokyo, Japan.

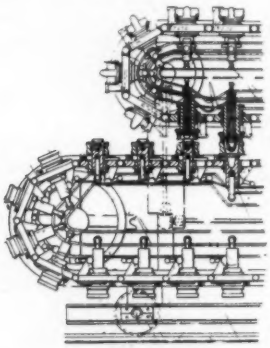
The invention relates to an improvement in glass rolls hitherto in use and consists in coating the cleaned surface of a steel cylinder with milk glass, with or without patterns or engraving thereon. The object of this invention is to obtain a roll which is very smooth and hard in its surface and is not corroded by chemicals.

Glass is a very compact substance and resists the action of chemicals; consequently it is sometimes used as a roll for printing patterns on woven fabrics or as a substitute for stone rollers. But the substance being very brittle, such a roll is easily damaged and is not fit for practical use. Attempts have been made to coat a metal core with melted glass, but the coefficient of expansion of metal and that of glass being greatly different, the glass coating is apt to crack. This invention consists in utilizing for such purposes that kind of glass which has practically the same, or nearly the same, coefficient of expansion as steel, so that the coating of such glass does not crack when cooling.

The patentee claims for his invention: a roll, consisting of a steel pipe the outer surface of which is perfectly smoothed and covered with a layer of milk glass which is rich in metallic constituents, the said layer of milk glass being either plain or etched or engraved with any desired patterns, substantially as and for the purposes set forth above.

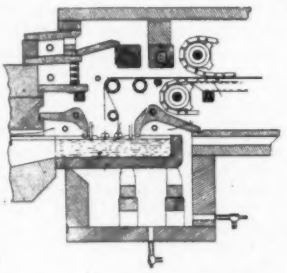
Manufacture of Glass Articles. U. S. 1,393,118. October 11, 1921. Robert Frederick Hall, of Birmingham, England.

This invention provides a suitable framework, two endless chains, an upper and a lower chain passing around the sprocket wheels or their equivalents. The links of these chains are constituted by plates or platforms, and the chains are so mounted and operated that the platforms on the upper and lower chains travel along during a portion of their course opposite to and in close proximity to one another. Each platform of one of the chains, for instance, the lower chain, carries the parison or finishing mold, and other associated parts, for manufacturing the glass article while the corresponding platform on the other chain carries the corresponding portions of the molds, the blowing device, the plungers and other associated parts for assisting in the manufacture of the article.



Method and Apparatus for Drawing Sheet-Glass. U. S. 1,394,283. October 18, 1921. Joseph P. Crowley, of Toledo, Ohio, assignor to the Libbey-Owens Sheet Glass Company.

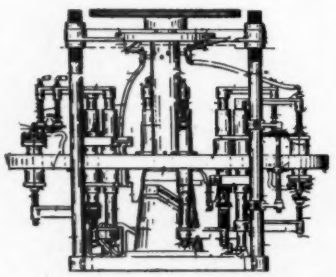
The invention relates to the manufacture of sheet-glass by methods of that type in which the sheet is drawn from a plastic mass, the opposite surfaces thereof being cooled and the edge portions being engaged with driven rolls which maintain the full width of the sheet. In such drawing operation it is necessary to pass the drawn sheet around a bending roll to change the direction from vertical to horizontal and also to contact the lower surface of the sheet with supporting rolls and with a drawing table. This contact with the rolls sometimes produces a marring of the surface of the glass which is injurious to the quality.



It is the object of the present invention to obtain a method of drawing glass in which there will be no contact which can produce a marring effect on either surface of the sheet. The essential feature of the method is in forming the contacting surface of glass which has a much smoother surface than the most highly polished metal. More specifically, the improved method consists in holding the drawn sheet out of contact with marring surfaces by supporting it upon a second drawn sheet which is intermediate with the same and the bending and supporting rolls.

Machine for Making Hollow Glassware. U. S. 1,394,092. October 18, 1921. Edward S. Hutton, of Lapel, Indiana.

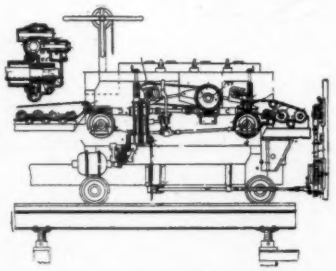
The object of this invention is to improve the construction and operation of mechanism for making hollow glassware, set forth in former letters patent No. 1,241,516, dated October 2, 1917, and No. 1,253,246, dated January 15, 1918. There are various new features constituting the improvements of said mechanism, whereby several defects of the construction in the former patents are overcome, and the automatic operation of the machine rendered more practical and satisfactory.



An end elevation of the machine with parts omitted is shown in accompanying illustration.

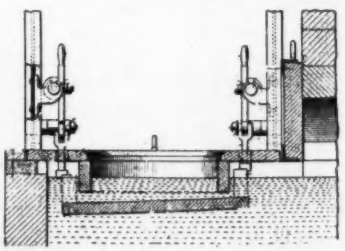
Process and Apparatus for Drawing Sheet Glass. U. S. 1,394,809. October 25, 1921. Irving W. Colburn, of Toledo, Ohio, assignor to the Libbey-Owens Sheet Glass Company.

The object of this invention is to provide a process and apparatus whereby sheet glass of uniform width and thickness may be drawn from the molten mass and subsequently annealed, after which it can be cut up into the desired sizes for the market. The invention consists in the process and apparatus for drawing the glass in a flat sheet horizontally, from the molten mass; in the mechanism for operating the drawing table either forward or backward; the means for regulating the temperature of the glass; in the construction of the glass holding apparatus or tank from which the glass is drawn; and in the arrangement and combination of the various parts.



Method of Drawing Glass. U. S. 1,396,339. November 8, 1921. William L. Monro, assignor to Window Glass Machine Company, Pittsburgh, Pa.

This invention relates to a method of drawing glass articles wherein the draw is made from a portion of a molten bath which is above a submerged diaphragm, and consists in adjusting the level of one part of the submerged diaphragm relatively to another part, which thereby varies the depth of the glass at the different portions of the diaphragm to compensate for varying heat conditions.



Glass Factory Equipment and Supplies

THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufacturers of the products described.

The Use of Boiler Compounds*

Scale and corrosion being so prevalent in steam boilers has brought upon the market many devices and methods aimed at overcoming the expense and danger resulting from the use of bad feed water. Many of these devices are irrational in application and some are simply ridiculous. The wilful introduction of any substance into a boiler which does not form steam, results in an increase of impurities in the water in the boiler, for we all know that evaporation removes only chemically pure water and the volatile impurities. Therefore, with this method, the boiler incidentally becomes an accumulator for both the impurities of the feed and the substances introduced to prevent the adherence of scale.

The theory underlying some boiler compounds may be correct chemically for the reactions desired, but their application within a boiler is attended with mechanical difficulties that prevent the maintenance of a proper ratio between them and the volume of water, and there is no accurate method of controlling the treatment to compensate for changes in impurities in the water. The irregularities in feeding produce boiler operating difficulties that prevent the accomplishment of the desired result. Under the most favorable conditions all that the most effective boiler compound can accomplish is to change the nature of the precipitate from one which adheres to the boiler to one which will be carried in suspension in the boiler water. The accumulation of the large amount of precipitates, if complete treatment is made, usually results in priming or foaming. A clean boiler with clear water is the most desirable condition.

The cost of boiler compounds to effect the complete prevention of scale is prohibitive for most water supplies. Compounds in general contain a very large percentage of water and usually the price per pound, including the water, is so high that sufficient compound is not used to precipitate all of the scale-forming substances; consequently both scale and sludge continue to accumulate within the boiler. The accumulation of sludge in the boilers resulting from the use of a compound can not be entirely removed by blowing off and therefore, frequent washing out becomes a necessity as well as removing scale.

Take for instance, a supply such as Lake Ontario, an analysis of which shows the following impurities:

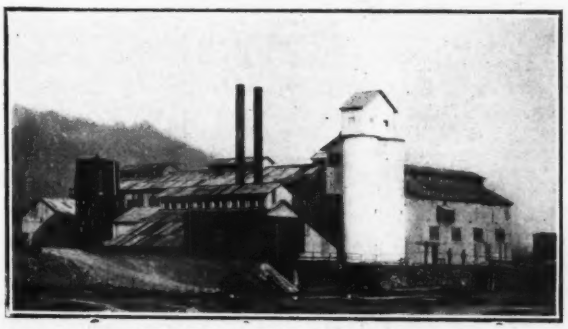
	Grains per U. S. Gallon
Volatile and organic matter	.45
Silica	.25
Iron and alumina oxides	.05
Calcium carbonate	5.00
Magnesium carbonate	.84
Magnesium sulphate	.96
Sodium sulphate	.07
Sodium chloride	.82
Sodium nitrate	.24
Total solids	8.68
Suspended matter	1.35
Free carbonic acid	.55
Incrusting solids	7.10
Non-incrusting solids	1.13

With this amount of scale-forming impurities being fed into a 300 H. P. water tube boiler holding 3,360 gallons of water, and the boiler kept in operation for six days of 24 hours, evaporating four gallons of water per H. P. per hour, there would be carried into the boiler 1,226,880 grains, or 175 lbs., of scale-forming impurities. Adding one of the so-called vegetable boiler compounds to the water even in the usual prescribed minimum dose of one pound per 100 H. P. per 10 hours or ¼ lb. per 1,000 gallons of water, would increase the impurities by 43 lbs., making a total of 218 lbs. or 454 grains per gallon in the water in the boiler. This shows only the accumulation resulting from the concentration of the scale-forming impurities and a minimum dose of compound. To prevent the adherence of scale, more compound would be required which would further increase the total of foreign matter in the boiler. The figures given do not include the suspended matter, or the sodium salts in the feed water; so that the concentration of these substances adds to the total of the soluble and suspended impurities befouling the water in the boiler.

*Abstracted from "Facts About Water Purification for Steam Generation," published by Wm. B. Scaife & Sons Company, Pittsburgh, Pa.

New Feldspar and Glass Sand Plants

Announcement has been made by Wm. J. Woods, assistant general manager of the Pennsylvania Glass Sand Company, whose general offices are at Lewiston, Pa., that the company has opened up several very large deposits of No. 1 Canadian potash feldspar in Ontario and Quebec, and that erection is proceeding at Rochester, N. Y., of a large modern grinding mill to handle the product of the Canadian mines. Mr. Woods states that these deposits are pronounced by authorities on feldspar to be much



NEW GLASS SAND PLANT OF PENNSYLVANIA GLASS SAND COMPANY AT KERMIT, VIRGINIA.

superior to the ordinary commercial product. An analysis of the spar which will be ground at the Rochester mill, made by Booth, Barrett & Blair, of Philadelphia, Pa., is as follows:

Silica	64.17%
Alumina	19.34
Ferric oxide	0.15
Lime	0.35
Magnesia	None
Soda	2.00
Potash	13.83
Ignition	0.23

The mill is being erected on a seven-acre tract in the city of Rochester, having railroad connections to three lines, the Buffalo, Rochester & Pittsburgh, the Pennsylvania, and the New York Central.

The plant will have a capacity of about 100 tons of ground spar per day. It is being constructed entirely of concrete, brick and steel, and equipped with the latest modern grinding machinery. It is hoped to have the plant in operation early in 1922.

The company only recently completed the building of the large glass sand producing plant shown in the cut at Kermit, Scott County, Virginia, on the Caroline, Critchfield & Ohio Railway. This plant is now running full capacity and is reported to be turning out a very high grade of melting sand.

The Louisiana Natural Gas Field

Press despatches from the South state that a natural gas field with "tremendous production potentialities" has been uncovered in Northern Louisiana, according to a report made public after an investigation by engineers of the Federal Bureau of Mines, conducted for the State on request of Governor Parker.

A productive area of 212 square miles, or, roundly, 135,000 acres in a solid block, located in Union, Ouachita and Morehouse Parishes, near the city of Monroe, and designated as the Monroe gas field, is outlined in the report.

The report estimates that the total amount of gas remaining in the reservoir is roundly 4,750,000,000,000 cubic feet, or thirty-two cubic miles, calculated at eight-ounce pressure above atmosphere, with indications that the volume is much greater, because the limits of the field had not been finally determined at the time the investigation was concluded.

Zirconium in White Glass

Successful experiments have been made in Germany in the use of zirconium oxide as an opacifier in the manufacture of white glass such as is used for table tops and similar purposes, according to J. Volkommer, of the Vitro Manufacturing Company, Pittsburgh, Pa., who recently returned from a trip to South America where he completed arrangements for the importation of Brazilian zircon and other products into the United States. Mr. Volkommer brought with him a sample of white glass made in Germany and reported to contain 6 per cent of zirconium oxide. The sample has a smooth, glossy surface and is said to possess high acid-resisting qualities.

Inquiries Received

43—Can you give us the names of several concerns located in the Southeast or close to water transportation who could supply us with corrugated packing and reshipping cases for glass bottles and jars?

Corning Man Favored for Ambassadorship

Despatches from Washington report that President Harding's first choice for appointment as Ambassador to Germany is Alanson B. Houghton, of the Corning Glass Works, Corning, N. Y., member of the House of Representatives for the 37th New York District. He is reported in the daily press to be favored by Senators Wadsworth and Calder and Speaker Gillett and is understood to have been endorsed by the New York State Republican organization and by Secretary Hughes.

Personal Notes

W. C. TIBBEY, general manager of the Tibbey-Brawner Glass Company, Punxsutawney, Pa., bottle manufacturers, was elected mayor of Punxsutawney, at the recent election.

JOSEPH M. NEENAN, who has served as president of the National Window Glass Workers' Union for many years and directed the organization's course through many difficult crises, has resigned to become associated with the Libbey-Owens Sheet Glass Company.

DR. EUGENE C. SULLIVAN, vice-president and director of the laboratories of the Corning Glass Works, Corning, N. Y., has been made general manager in charge of manufacturing operations in all of the plants of the Glass Works.

Recent Deaths

W. D. CAMP, one of the first window glass maunfacturers in the country, died at Huntington, W. Va., on November 12. Mr. Camp was born in Winslow, N. J., July 2, 1841, but left there with his family at an early age and settled in Pittsburgh, where he took up the trade of glass gatherer in the old Wightman factory. He was married in Pittsburgh and lived there until 1870, when he moved with his family to Bellaire, Ohio, later becoming one of the original stockholders in the Bellaire Window Glass Company.

Mr. Camp then returned to New Castle, Pa., in 1881, and was employed in the old Union factory, and later at the plant owned by Knox & Fultz and known as the Shenango factory.

When the Camp Glass Company was organized at Smethport, Pa., in 1898, Mr. Camp became the manager, and also managed the plant of the Smethport Glass Company, after it was taken over by the Camp interests. Several years later he became manager of the Clarksburg Window Glass Company, Clarksburg, W. Va., but returned to the Camp Glass Company's factory at Mount Vernon, Ohio. Mr. Camp was active in that company's affairs in an official way up to a short time before his death.

He is survived by three sons and four daughters as follows: Thomas W. Camp, Smethport; Dan and Harry Camp, Huntington; Mrs. Norma Keefer, Smethport; Mrs. R. W. Calderwood, New Castle, Pa.; Mrs. F. F. Riggall, Huntington, and Mrs. William Westcoat, Huntington.

JOHN JACOB MEYER, aged 62, secretary, treasurer and general manager of the Glenshaw Glass Co., Inc., Glenshaw, Pennsylvania, died at the family residence, in Glenshaw, on Saturday, November 12, 1921, where he has resided for the past twenty years.

Mr. Meyer was born in O'Hara Township, Allegheny County, Pennsylvania, and for many years prior to 1895 was engaged in the cooperage business in Pleasant Valley, near Sharpsburg. At the latter date he discontinued this business and became identified with the Glenshaw Glass Co., later becoming general manager of the concern, which position he held until his death, in addition to being its secretary and treasurer.

For many years Mr. Meyer was an important personage in all meetings having anything to do with the bottle industry and in 1909 met single handed the entire Bottle Blowers' executive committee and arranged prices for ware made on the United Bottle Machine, which was a model for its day, and some time later was appointed to the National Bottle Manufacturers' Association executive committee, which appointment he held until his death.

In 1882 Mr. Meyer was married to Miss Amalia Seemann, who survive him, also four sons.

JAMES HOARE, the well known cut glass manufacturer of Corning, N. Y., died on November 4 at the age of seventy-four. He is survived by his wife, a son and seven daughters.

MATSUTARO AYAKI, thirty-one years old, of Tokio, Japan, a widely known chemical engineer, died on November 27, at a private hospital in Brooklyn, N. Y. Mr. Ayaki had just returned on November 24 from abroad, where he had been representing the Asohi Glass Company of Japan.

Coming Meetings and Other Events

AMERICAN CERAMIC SOCIETY.—Twenty-first annual meeting at St. Louis, Mo., February 27 to March 2, 1922.

AMERICAN SOCIETY FOR TESTING MATERIALS—1922 annual meeting, Engineering Societies Building, New York City, December 5-9, 1921.

AMERACAN SOCIETY FOR TESTING MATERIALS—1922 annula meeting, Atlantic City, latter part of June, 1922.

NATIONAL GLASS DISTRIBUTORS' ASSOCIATION.—Seventh annual meeting at William Penn Hotel, Pittsburgh, Pa., December 7, 1921, at which officers and the executive committee will be elected.

News of the Trade

THE GLASS INDUSTRY will be glad to receive notices of new glass manufacturing projects, plant extensions, removals, personal items, etc.

According to a press report, the FORD MOTOR COMPANY of Detroit, Mich., are successfully rolling plate glass for windshields.

R. R. Dickson, president of the WOLVERINE GLASS COMPANY, Saginaw, Mich., reports that they are dismantling their bottle plant at that point.

THE ST. LOUIS BRASS COMPANY, St. Louis, Mo., according to a press report, is having plans prepared for a new glass factory to be erected on Delmar Boulevard, and will be equipped with modern machinery.

THE UNITED STATES SHEET & WINDOW GLASS COMPANY has been organized and financed, it is reported, by the Libbey-Owens interests. Capitalization consists of 30,000 shares preferred stock of $100 par value each, and 100,000 shares of common stock of no par value.

THE INDUSTRIAL GLASS MANUFACTURING COMPANY, Cameron, W. Va., has been incorporated, according to a press report, with a capital stock of $100,000. The incorporators are L. M. C. Scherr, O. L. Wambaugh, A. M. Darquenne, O. U. Woodell and W. J. Wambaugh.

THE CAROLINA FELDSPAR COMPANY, Inc., Asheville, N. C., according to J. Frazier Glenn, president, is preparing to grind feldspar in different grades and is erecting a modern mill for this purpose which they expect to have in operation about December 15.

THE INTERSTATE WINDOW GLASS COMPANY is enlarging the furnace and installing labor saving devices at its No. 7 plant at Okmulgee, Okla., which, it is reported, will increase the capacity more than 25 per cent. It is expected that the plant will begin operations about January 2, 1922.

THE ORIENTAL ART GLASS COMPANY, Chicago, Ill., which was recently incorporated, is erecting a building and will install a small tank and 10 pot furnace to be built by the B. F. Morton Company, of Blawnox, Pa. Robert Malcom, president, reports that they expect the plant to be in operation by December 15, and the products will include colored sheet glass, antique and iridescent glassware.

About 200 city officials, members of the Chamber of Commerce and business men and manufacturers of Albany and Troy, were the guests of the HIRES-TURNER GLASS COMPANY, at a luncheon on November 16, at the formal opening of the company's new warehouse and mirror factory on Tivoli street, Albany, N. Y. President Hires and other officials were present from Philadelphia, Pa., where the main office of the company is located.

THE J. J. QUERTINMONT GLASS COMPANY, Point Marion and Fairchance, Pa., has increased its capital from $80,000 to $1,000,000. The company will install the Fourcault sheet glass machine and Mr. Duliere is at present in Belgium for the purpose of purchasing necessary equipment and also to study the operation of the machine. J. J. Quertinmont, president of the company, states that they expect to be making glass by the Fourcault process by July, 1922.

Business Publications

SMITH GLASS BATCH MIXER.—The T. L. Smith Company, Milwaukee, Wis. Bulletin 404. Describes and illustrates the Smith mixer, contains views of installations in well-known glasshouses, list of customers, mixer specifications, capacities, etc.

FACTS ABOUT WATER PURIFICATION FOR STEAM GENERATION.—Wm. B. Scaife & Sons Company, Pittsburgh, Pa. An interesting 20-page discussion of the various methods in use for preventing the formation of, or overcoming, scale in steam boilers.

EAGLE-PICHER PRODUCTS.—The Eagle-Picher Lead Company, Chicago, Ill. A very attractive, well printed catalog of the Company's products, covering lead ore and many derivatives including besides red lead and litharge for the glass trade, lithopone, red, white and blue lead and other paint materials, lead pipe and plumbers' lead fittings, sheet, pig and ingot lead, babbitt metals, solders, also slab zinc and zinc oxide. Eleven of the Company's large plants are illustrated, the control laboratories operated at each of the plants are referred to, as well as the research laboratory at Jopin, Mo., and a complete "tree" showing the products derived from lead ore is bound into the catalog.

LINK-BELT CONVEYORS. Book No. 215. Ling-Belt Company, Chicago, Ill. A 72-page catalog of the company's belt-conveyors and individual parts and accessories thereof, including belts, drive, idlers, troughing rolls, trunnion bearings, trippers, chutes, belt tighteners, etc. Diagrams of typical conveyors are shown, horsepower and capacity tables and other data given and methods suggested for figuring the tension required for conveyor belts when going around drive pulley, additional horsepower required for inclined conveyors, ply of belts, diameter of shafting, etc. A variety of applications of Link-Belt conveyors are illustrated by views of actual installations. This catalog is refreshingly free from long-drawn out descriptions and "glittering generalities," practically all of the space being devoted to giving the reader specific information pertaining to the products cataloged.

Owens Bottle Earnings

The statement of earnings of the Owens Bottle Company, Toledo, Ohio, for the nine months ended September 30, shows surplus after charges and Federal taxes, of $1,485,865, which after preferred dividends was equivalent to $1.42 a share earned on the $17,371,990 of common stock of $25 par value. In the same period of 1920, the company reported a surplus of 3,989,360, equivalent to $7.97 a share on the $10,932,626 common stock then outstanding.

The comparative report is as follows:

	1921.	1920.	1919.
Manufacturers' profits and royalties	$2,060,321	$3,551,207	$2,235,641
Other income	751,015	528,962	171,645
Total income	$2,811,336	$4,080,169	$2,407,286
General expenses, etc.	1,095,471	800,341	721,157
Net earnings	$1,715,865	$3,279,828	$1,636,129
Net earnings subsidiary companies	.....	1,841,132	1,278,851
Total net	$1,715,865	$5,120,960	$2,964,980
Estimated Federal tax	230,000	1,131,600	542,192
Surplus	$1,485,865	$3,989,360	$2,422,788

Earnings for the full year 1920 were at the rate of more than $8 a share.

Monthly Summary of Foreign Commerce of the United States in Glass

Corrected to October 18, 1921.

IMPORTS OF GLASS AND GLASSWARE

	September				Nine months ending September					
	1920		1921		1919		1920		1921	
Glass and glassware:	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Bottles, vials, carboys, etc., plain, empty or filled ....lbs. dut.	598,890	$30,442	975,380	$36,245	1,185,196	$65,223	4,403,072	$207,522	6,210,151	$268,730
Bottles, decanters, and other glassware, cut or ornamented ....dut.	.....	150,880	.....	137,017	.....	286,776	.....	729,020	.....	1,079,056
Optical instruments, including lenses and spectacles .... dut.	.....	98,979	.....	94,612	.....	203,455	.....	645,616	.....	795,686
Sheet and plate glass—										
Cylinder, crown, and common window glass, unpolished ....lbs. dut.	255,869	27,849	1,167,264	77,333	555,923	68,927	3,907,201	399,219	35,608,360	2,039,885
Plate glass, cast, polished, unsilvered ....sq. ft. dut.	315,949	260,233	165,041	97,374	11	5	1,385,649	1,138,214	1,826,518	1,360,241
Plates or disks, rough-cut, for optical purposes ....lbs. free	70,747	76,902	13,626	21,268	420,261	292,074	680,412	735,095	572,667	525,940
All other ....dut.	.....	259,703	.....	196,050	.....	437,526	.....	1,396,138	.....	1,916,076
Total	.....	$904,988	.....	$659,899	.....	$1,353,986	.....	$5,250,824	.....	$7,985,614

EXPORTS OF GLASS AND GLASSWARE

Glass and glassware:										
Bottles, demijohns, carboys, and jars....	.....	880,701	.....	188,160	.....	3,730,875	.....	7,316,620	.....	3,989,575
Chemical glassware	.....	34,281	.....	18,176	.....	146,420	.....	181,928	.....	189,008
Common window glass, boxes (50 sq. ft.)..	61,397	383,522	1,996	15,197	738,397	5,045,238	461,552	3,134,143	53,989	430,264
Exported to—										
Canada	31,401	171,198	477	4,922	126,375	681,698	234,165	1,447,698	7,314	57,211
Mexico	6,470	46,597	721	4,244	18,084	132,334	24,109	195,790	17,919	147,811
Cuba	6,577	55,804	229	2,112	12,441	91,935	32,297	233,792	6,055	54,834
Argentina	1,602	13,175	.....	.....	83,868	586,322	15,479	127,994	2,440	17,205
Brazil	4,244	26,785	.....	.....	53,287	340,518	27,461	194,704	2,128	12,191
Chile	400	3,391	.....	.....	25,549	171,864	11,235	68,345	168	1,791
Uruguay	868	4,843	.....	.....	.....	.....	4,933	31,247	2,318	14,077
China	816	8,679	.....	.....	.....	.....	23,150	158,859	1,190	11,822
Japan	3,920	14,135	.....	.....	9,484	98,757	19,759	158,590	70	944
Australia	.....	.....	.....	.....	97,336	587,771	9,737	75,732	1,648	12,423
New Zealand	.....	.....	.....	.....	24,873	139,793	3,055	23,630	8	54
Other countries	5,099	38,915	569	3,919	287,100	2,214,246	172	762	731	99,901
Cut or engraved glassware....	.....	38,770	.....	10,729	.....	177,012	.....	305,322	.....	146,698
Plate glass, unsilvered....sq. ft.	315,663	277,924	157,475	76,900	6,357,200	3,677,269	3,366,193	2,212,785	1,855,174	1,125,854
All other	.....	1,088,789	.....	313,562	.....	6,032,175	.....	8,629,028	.....	6,295,511
Total glass, etc....	.....	$2,703,987	.....	$622,724	.....	$18,808,989	.....	$21,779,826	.....	$12,176,914

Current Prices of Glass-Making Materials

From quotations furnished by various manufacturers and dealers

November 28, 1921

	Carlots	Less Carlots
Alumina hydrate ....lb.	.05½	.06
Arsenic trioxide (dense white, 99%) ....lb.	.05¾–.07½	
Barium carbonate ....ton	46.00	55.00
Bone ash ....lb.	.04	.04½
Borax ....lb.	.05¼–.05½	.05½–.06
Borax, fused, and mesh....lb.	.19	.20
Boric acid, fused....lb.	.35	.35
Cobalt oxide ....bbls. lb.		2.00
Cobalt oxide ....10 lb. tins, lb.		2.10
Copper oxide, red....lb.		.17– .20
Copper oxide, black....lb.	.23	.26
Copper oxide, black, prep'ed, lb.		.30
Cryolite ....lb.		.10
Feldspar, 100 mesh....ton	18.00	
Fluorspar, powdered white, 90% ....ton	38.00	
Kaolin ....ton	17.00	25.00
Lead oxide (red lead, Pb_3O_4) lb.	.08	.08¼
Litharge (PbO) ....lb.	.07½	.07¾
Lime—		
Hydrated ....ton	45.00	
Burnt, ground, in bulk....ton	7.50	
Burnt, ground, in paper sacks ....ton	9.50	
Burnt, ground, in 280 lb. bbls per bbl.		2.05
Manganese (85% MnO_2) ....lb.	.03½	.04 –.06½
Potassium carbonate—		
Calcined 90% ....lb.	.06	.07
Hydrated 90% ....lb.	.05½	.06
Potassium nitrate ....lb.	.09½	.09¾
Powdered blue ....lb.		.24–.26
Powdered blue (std. formula) lb.		.45
Salt cake, for glassmakers...ton	21.00	.01½–.02 lb.
Selenium ....lb.		1.95–2.25
Soda ash, 58% dense, 48% basis		
Bulk ....100 lb.	1.50	1.55
Bulk, on contract....100 lb.	1.45	
Sodium nitrate, refined ....lb.	.06⅛	.06¾
Sodium selenite ....lb.		2.25
Sulphur (flowers) ....lb.	.02¼	.02¾
Sulphur (flour, heavy)....lb.	.02	.02¼
Zinc oxide (Zno) ....lb.	.07½	.08

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

Pittsburgh Stock Exchange—November 28

	Bid	Asked	Last
American Window Glass Machine common	70¼	72	70¼
American Window Glass Machine pfd....	80	85	79
American Window Glass preferred.....	—	96	96
Pittsburgh Plate Glass.....	120	130	130
U. S. Glass	40	50	50

Market strong with pronounced strength in Pittsburgh Plate Glass.

American Window Glass Machine has been the most active of the Pittsburgh glass stocks, with a net gain of 3¼ joints since last report. The glass companies in this vicinity are still operating on a reduced scale but there has been some improvement.

Wheeling Stock Exchange—November 28

	Bid	Asked	Last
Fostoria Glass Company	115	120	112
Hazel Atlas Glass Company.....	138	140	140
Imperial Glass Company.....	92½	100	100
Central Glass	—	154	155

The Wheeling market has reflected the improved operations in the local plants. The Imperial Board restored its dividend in November to its old 1¼% quarterly basis after passing two dividends. The Hazel Atlas Glass Company has changed the date of their annual meeting from December to February in order to make its fiscal year coincide with the calendar year. The Central Glass Company is operating two of its three furnaces and has accumulated orders sufficient to carry it over the first of the year. Fostoria has been especially strong with no offerings under 120.

Toledo Stock Exchange—November 28

Libbey Owens Sheet Glass common.....	115	120	116
Libbey Owens Sheet Glass preferr'd.....	97	97¾	97¾
Owens Bottle Machine common.....	26	28	27
Owens Bottle Machine preferred.....	96½	97½	97

Market firm with active and strong market in Libbey Owens.

The Glass Industry

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Glass Technology, Engineering, Raw Materials,
Glass Factory Management and Equipment

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